# EARTHQUAKE SAFETY IN UTAH



A Progress Report on the Activities and Accomplishments of the

# UTAH SEISMIC SAFETY COMMISSION

for the Period July 1, 1996 to June 30, 2000

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#### **FOREWORD**

We know for certain that Utah's people, built environment, and economy are all exposed to a real and constant earthquake threat. Most Utahns view earthquake dangers as more unlikely than they truly are, and risk—the likelihood of loss—is increasing because of dramatic population and urban growth in earthquake-prone areas like the Wasatch Front.

A report issued in September 2000 by FEMA, the Federal Emergency Management Agency, called *HAZUS99 Estimated Annualized Earthquake Losses for the United States*, helps to place Utah's earthquake risk in perspective. According to the report, projections of direct economic losses in Utah to the building stock alone (damage repair, rebuilding, loss of contents and use)—factoring in both infrequent large earthquakes and more frequent moderate-size shocks—add up to \$51.5 million per year on an annualized basis. Like an actuarial statistic, this is the loss that is expected, averaged over time.

The FEMA report ranks Utah **seventh** in the Nation in absolute risk and **sixth** in relative risk when one takes the ratio of the average annualized earthquake loss to the replacement value of the building inventory. The report emphasizes that the loss estimates are extremely conservative because they do not cover damage and losses to critical facilities, transportation systems, and utility lifelines—nor indirect economic losses (ripple effects on economic sectors that do not sustain direct damage).

What about losses in a single big quake? A study reported in 1997 by the Applied Technology Council in California estimates that the expected direct economic losses to buildings and lifelines for a magnitude 7.5 earthquake in Salt Lake County would be approximately \$12 (±3) billion. If one adds indirect economic and social losses (casualties, displaced households, and short-term shelter needs), total losses could be 20 percent higher, putting the total in the range of \$11 billion to \$18 billion.

Will such a "big one" happen in our lifetime? Geologists debate whether the chance of a big quake on the Wasatch fault in the Salt Lake Valley in the next 50 years is closer to 5 percent or 25 percent. In either case, it's clear that we're playing Russian roulette with stored-up earthquake energy on the Wasatch fault—and other active faults—in Utah.

During the past 5600 years, large earthquakes have occurred on the Wasatch fault's Salt Lake City segment about once every 1400 years, and the last one was almost that long ago. The Wasatch fault has unleashed a magnitude-7-size shock along one or another of its five segments between Brigham City and Nephi every 350 years on average in the past 5600 years. The last one happened about 600 years ago near Provo.

Utah is not as prepared as it needs to be to withstand, respond to, and recover from future earthquakes—including damaging, moderate-size shocks in the magnitude 5 and 6 range. Since the 1950s, shocks of this size have occurred in the Utah region one to three times every decade, and growth is increasing the odds that populated areas will be hit.

The mission of the Utah Seismic Safety Commission is to improve earthquake safety in Utah—to save lives, prevent injuries, protect property and the environment, and reduce social and economic disruption from earthquakes. Individuals and communities don't have to be at the complete mercy of earthquake forces. We **can** have some control, and we **can** reduce earthquake losses.

Lessons learned from earthquake disasters around the world point the way to improving earthquake safety in Utah:

- heightened public awareness and consumer demand for earthquake safety
- better building codes and enforcement
- ♦ strengthening of vulnerable buildings
- prudent urban planning and development
- improved design and protection of critical infrastructure
- better tools and readiness for emergency response and recovery
- better information on geological hazards and their effects, especially in urban areas
- and the joint commitment and leveraging of public and private funding to achieve the above

This progress report on the activities and accomplishments of the Utah Seismic Safety Commission during 1996-2000 includes many successes. What has worked best for the Commission has been an ongoing response to its statutory charge to "act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures."

We've taken most of the easy steps towards earthquake preparedness that require only modest resources. There remains the challenge of taking key long-term defensive actions that will require larger funding in the range of hundreds of thousands to millions of dollars. The willingness of the public and private sectors in Utah to make such investments ought to be guided by sensible principles of risk management—as was the praiseworthy decision to use high seismic design standards in rebuilding I-15.

Faced with the projection of annualized earthquake losses of \$51.5 million per year, or with the prospect of losses of \$11 billion to \$18 billion from a single large earthquake on the Wasatch fault, decision-makers in Utah must deal with this risk in informed realistic ways.

For our part, we on the Utah Seismic Safety Commission are keenly aware of the dangerous mix in the Wasatch Front area of (1) dramatically increasing population,

(2) complex and costly urban infrastructure, and (3) pent-up earthquake energy. And we are equally aware that earthquakes in Utah are not just a Wasatch Front problem.

We pledge to continue our efforts to advance earthquake safety in Utah—and we look forward to a continuing partnership with public and private leaders to reduce the impact of future earthquakes on people, homes, businesses, and communities in Utah.

Walter J. Arabasz Chair, Utah Seismic Safety Commission

#### **EXECUTIVE SUMMARY**

Since 1995 when the Commission created A Strategic Plan for Earthquake Safety in Utah, 27 (or three-fourths) of its 35 strategic objectives have either been successfully met or are being addressed in an ongoing way. This report describes varied activities and accomplishments of the Commission—either initiated, planned and executed, influenced, or engaged in—during the four-year period from July 1996 through June 2000. An earlier progress report for the period from July 1994, when the Commission was formed, through June 1996 was issued in November 1996.

This report also details the results of a survey on earthquake awareness issues. The survey, which supplements an earlier survey summarized in the 1996 progress report, was sent to counties, cities, and major employers throughout the state. The latest survey was intended to gather information on earthquake-related regulations, enforcement activities, reviews, educational practices, and mitigation efforts in Utah by private and governmental entities, and to evaluate the level of commitment those entities place on earthquake safety. Generally speaking, the survey shows that the larger the entity, public or private, the higher the priority given to earthquake safety.

The USSC maintains five Standing Committees, greatly enlarging the number of individuals actively involved in carrying out the work of the Commission. These committees respectively focus on (1) Awareness and Education (incorporating an earlier separate committee on Emergency Management), (2) Engineering and Architecture, (3) Geoscience, (4) Lifelines and Infrastructure, and (5) Intergovernmental Relations. The Commission also depends heavily upon the Utah Division of Comprehensive Emergency Management, the Utah Geological Survey, and the University of Utah Seismograph Stations—three key partners in Utah's state earthquake program—to pursue the Commission's goals.

Some of the notable activities and accomplishments of the Commission during the report period, organized under nineteen topical issues and actions, include the following:

- Seismic safety in school construction: Beginning in 1997, advocacy by the Engineering and Architecture Committee—and consensus-building with school districts—resulted in the adoption of regulations by the State Board of Education in 1999 that require all new school construction (and major additions to existing facilities) in regions of moderate to high seismic risk to undergo seismic quality control reviews by a licensed structural engineer.
- Prepared schools: The Schools Subcommittee of the Awareness and Education Committee gained the cooperation of school administrators, teachers, and parents in helping prepare K-12 schools for earthquakes and other disasters. A 1998 survey of emergency preparedness sent to 731 public schools (50 percent response) and 102 private schools (25 percent response) has formed the basis of an ongoing "Prepared Schools Project" under which schools can qualify for reduced insurance premiums. The Schools Subcommittee received a national award in excellence for educational outreach to schools

for its project, "Prepared Schools for Effective Drills and Safe Surroundings."

- Involving businesses and institutions in seismic safety planning: The Awareness and Education Committee planned and convened three conferences—in 1996, 1997, and 1998—to motivate businesses and institutions to include earthquake safety in their contingency planning and to help businesses survive and recover from earthquakes. The conferences successfully attracted more than 500 participants, received prominent newspaper and TV media coverage, distributed volumes of reference material and self-help guides, and raised public awareness of practical steps that can increase earthquake safety and economic survival.
- Recognizing efforts of businesses, governments, schools, and individuals to improve seismic safety in Utah: In 1996 and 1997 the Commission publicly recognized and made awards for excellence and outstanding contributions to earthquake safety in Utah. In 1996 the Award for Outstanding Contributions to Earthquake Saftey in Utah went to the Salt Lake Tribune and its science writer, Lee Siegel (for informative reporting on many earthquake-related issues in Utah); in 1997, to Mountain Fuel Supply Company (for seismic strengthening of its facilities and varied efforts in earthquake awareness). Certificates of Excellence were awarded in 1996 to Brigham Young University (for campus- and community-wide safety efforts), the Salt Lake City School District (for pioneering efforts in seismically strengthening local schools), and Hyde Park City (for diverse community actions in earthquake preparedness); in 1997, to the Utah Department of Transportation (for state-of-the-art seismic design in the Interstate 15 reconstruction project).
- Recognition of efforts by Commission staff to advance earthquake education and awareness: Three public-education projects undertaken in coordination with the Commission received awards in excellence in 1997 from the Western States Seismic Policy Council. These involved (1) providing earthquake-related curriculum material and training to teachers in Utah schools together with developing and circulating a traveling exhibit on *Earthquakes in the Intermountain West*, (2) publishing *The Utah Guide for the Seismic Improvement of Unreinforced Masonry Buildings*, and (3) producing a series of maps and brochures that describe earthquake hazards and risk in Utah.
- Building code enforcement and plan review: In 1996 the Engineering and Architecture Committee prepared a White Paper on building-code enforcement and plan review recommending amendments to state law that would ensure code enforcement and provide for licensing or certification of building officials and plans examiners throughout the state. Draft legislation based on these recommendation failed in the Utah legislature in 1997. There have been ongoing efforts to effect rules changes through the Utah Division of Professional Licensing.
- Seismic strengthening of existing buildings: Since April 1999 the Commission has

been (1) actively advocating seismic upgrading of unreinforced masonry buildings when their lives are extended through major remodeling and (2) enforcement of an existing statewide ordinance that requires building owners to install roof anchors and parapet bracing when reroofing their buildings. These efforts involve partnering with the Structural Engineers Association of Utah and the Uniform Building Code Commission.

- Seismic vulnerability of state buildings: In 1996 the Commission attempted unsuccessfully to advocate dedicated state funding for progressively remediating the seismic vulnerability of older state-owned buildings. In October 1999, Commissioner Matthias Mueller of the Division of Facilities Contruction and Management outlined results of a survey of 193 older state buildings indicating that 111 of the 193 buildings surveyed by that date needed structural upgrading. Progress is being incrementally made in seismically strengthening selected state-owned buildings as part of major remodeling projects.
- The safety of construction in downtown Salt Lake City: In 1998 and 1999 the Commission served as a sounding board and forum for concerns about fault-displacement hazards associated with active faults in the Salt Lake City metropolitan area. The public discussions related to (1) active-fault maps and geotechnical reports required for building permits and (2) whether an active fault is under the site of an expansion to the Salt Palace. Some issues for earthquake-hazard ordinances in Salt Lake County remain unresolved. For the Salt Palace construction, both Salt Lake County and Salt Lake City accepted a finding that geological features uncovered in the Salt Palace excavation were liquefaction-induced and not directly associated with an active fault.
- Vulnerability of the state's lifelines, infrastructure, and water and wastewater systems: Since 1998 the Lifelines and Infrastructure Committee has been involved in an ongoing project to create a GIS-based inventory of all the important lifelines in Utah, including transportation routes and utility corridors, with a primary focus on the Wasatch Front area. The Commission sponsored educational presentations to operators of water and wastewater systems in Utah to help them evaluate the seismic vulnerability of their own systems. The Commission is also partnering with other state groups to make Utah's critical infrastructure disaster-resistant.
- Interstates 15 and 80 bridge reconstruction: In 1996, four members of the Commission's Geoscience Committee served on an I-15 Corridor Seismic Advisory Committee to assist the Utah Department of Transportation (UDOT) in establishing seismic design criteria and in reviewing and making recommendations on the acceptability of earthquake-related studies and design recommendations made by I-15 consultants. The committee persuaded UDOT to use design standards for I-15 that were higher than those it conventionally uses so that freeway bridges would not collapse but at most sustain reparable damage during a large earthquake on the Wasatch fault. UDOT is

also attending to reinforcement of aging highway bridges on I-80 between State Street and Parley's Canyon in the Salt Lake Valley.

- Local government needs for geoscience information and training to reduce risks from earthquakes and other geologic hazards: In 1999 the Geoscience Committee and the Utah Geological Survey jointly established a Guidelines Advisory Committee to work with local governments to determine what information products and services relating to geologic hazards were needed, who should provide them, and what resources were needed. A final report was completed in late 1999. The committee addressed the possible roles of local government insurers—Utah Risk Management Mutual Agency and Utah Local Governments Trust (UGLT)—in encouraging risk reduction.
- Recognizing earthquake hazards, assessing risks for communities, and preparing communities for emergency response: Since 1997 the Utah Division of Comprehensive Emergency Management, together with the Commission's Emergency Management Committee, has been involved in (1) implementing Hazards United States (HAZUS), a geographic information system-based software package that identifies earthquake hazards and assesses the loss-vulnerability of communities and (2) providing Community Emergency Response Team (CERT) training. Both projects are greatly advancing earthquake preparedness in Utah.
- Real-time earthquake information system and strong-motion recording: Initiatives aimed at strong-motion instrumentation and real-time earthquake information capabilities have long involved scientists and engineers from the University of Utah Seismograph Stations (UUSS), the Utah Geological Survey, and the Commission. Efforts finally bore fruit in 1999 with the announcement that UUSS would receive federal funding during fiscal year 2000 under a cooperative project with the U.S. Geological Survey to begin building a real-time urban strong-motion network in the Ogden-Salt Lake City-Provo urban corridor before the 2002 Winter Olympics. The system will rapidly provide automatically-generated earthquake alerts and computer maps of the intensity and extent of strong ground shaking within minutes of a sizable local earthquake.
- A Unified Utah Earthquake Master Model: In 1997 the Commission and its Geoscience Committee deliberated on new information and an action proposal for "A Unified Utah Earthquake Master Model" from Professor Robert Smith, University of Utah, relating to deformation measurements across the Wasatch fault from Global Positioning System (GPS) monitoring. While the Commission has adopted a cautious approach to interpreting higher-than-expected rates of deformation reported from the GPS monitoring, Professor Smith continues to provide a valuable service in developing and operating arrays of GPS instruments for continued monitoring of earth deformation in Utah.

- National Science Foundation request for proposals to fund earthquake engineering centers: In 1996 the Commission voted unanimously to support a competitive proposal to the NSF from a consortium—including Brigham Young University, Utah State University, the University of Utah, Portland State University, the Oregon Department of Mineral Industries, and the Utah Geological Survey—to develop an earthquake-engineering research center in Utah. In April 1997, after the proposal had been submitted, NSF revised the program announcement and ultimately funded centers in California, New York, and Illinois.
- The relevance of Seismic Safety Commissions: In 1999 an invited presentation by the chair of the Nevada Earthquake Safety Council inspired the Commission (1) to seek an amendment to the Utah Seismic Safety Commission Act of 1994 that would allow the USSC to solicit and receive external funding and (2) to pursue more aggressively better building codes and their enforcement for earthquake safety. The Utah Seismic Safety Commission Act was successfully amended in the 2000 general session of the Legislature, and the Engineering and Architecture Committee—jointly with the Structural Engineers Association of Utah—began to champion the seismic strengthening of existing buildings.
- ▶ **Disaster-resistant communities:** The dramatic growth and development in Utah's Greater Wasatch Area increases the urgency of taking actions that will make Utah's communities more disaster resistant. Funding from the Federal Emergency Management Agency under *Project Impact* to selected cities (Centerville, Salt Lake City, Logan, Moab, Provo) is advancing this goal.
- Commission Meetings Outside the Salt Lake City Area: Quarterly meetings of the Commission outside the Salt Lake City metropolitan area have become a valuable outreach tactic to promote earthquake awareness and planning. In April 1998 the Commission met in Brigham City with the public and with officials from Box Elder, Cache, and Weber Counties. In April 2000 the Commission similarly traveled to the campus of Brigham Young University in Provo to meet with local and county officials in Utah County. [In April 2001 the Commission will meet in Ogden.]

The Commission's priorities for the future include: expanding its "Prepared Schools" program; advocating requirements for strengthening older existing buildings; improving the survivability and post-earthquake usability of essential service buildings; evaluating the seismic vulnerability of Utah's lifelines; ensuring that geologic-hazards investigations are performed for the safe siting of all new schools and critical public facilities; assisting local governments to reduce risks from earthquakes and other geologic hazards; supporting continued development of urban strong-motion monitoring and a real-time earthquake information system in the Wasatch Front area; ensuring that design professionals and building officials are kept current on relevant geoscience information; and advocating the disclosure of known geologic hazards in real-estate transactions so that homebuyers are appropriately informed of the risk they are assuming.

#### INTRODUCTION

In 1994 the Utah State Legislature created the Utah Seismic Safety Commission (USSC) with the explicit charge (see Appendix B) to do the following:

- (a) review earthquake-related hazards and risks to the state of Utah and its inhabitants;
- (b) prepare recommendations to identify and mitigate these hazards and risks;
- (c) prioritize recommendations and present them to state and local governments or other appropriate entities for adoption as policy or loss reduction strategies;
- (d) act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures;
- (e) prepare a strategic seismic planning document to be presented to the State and Local Interim Committee before the 1995 general session of the legislature; and
- (f) periodically update the planning document and monitor progress towards achieving the goal of loss reduction.

The mission of the Utah Seismic Safety Commission is to improve earthquake safety in Utah—to save lives, prevent injuries, protect property and the environment, and reduce social and economic disruption from earthquakes. The Commission's 1995 A Strategic Plan for Earthquake Safety in Utah, which has provided an effective "road map" for action (see Appendix C), set out the following guiding principles:

- 1. There is a real and serious danger of both life-threatening and damaging earthquakes in Utah in our lifetimes.
- 2. We as individuals and collectively can take significant actions now to reduce the loss of life, property damage, and long-term economic impact in the future.
- 3. Implementing an earthquake-safety plan for Utah is a long-term process.
- 4. Strategies to safeguard lives and property from earthquakes must be sensitive to financial and regulatory burdens. Many actions can be taken now without great expense that will make Utah safer tomorrow.

Earthquakes can't be prevented, but human behavior and the built environment can be modified to mitigate the impact of such events. As recent victims in earthquake-ravaged regions of Turkey, China, Taiwan, Japan, and the United States can attest, preparedness is important and can pay dividends.

One of the significant accomplishments of the Commission has been to provide leadership and coherence to Utah's state earthquake program. Besides the Commission's 15 members, Commission activities actively involve, on an ongoing basis, more than 35 interested individuals

on five standing committees (Appendix A): Awareness and Education, Engineering and Architecture, Geoscience, Lifelines and Infrastructure, and Intergovernmental Relations.

The Commission has been particularly successful in meeting its charge to "act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures." Successes in promoting earthquake awareness and loss-reduction actions have notably come from media attention to issues raised at quarterly meetings (including meetings at sites outside of Salt Lake City), focused activities of the standing committees, and Commission sponsorship or co-sponsorship of special-topic conferences.

In the main body of this report, we describe specific activities and accomplishments of the Commission during the four-year period, July 1996 through June 2000. Instead of a chronological recital, they are organized under key issues and actions.

Separately, in Appendix E, we describe and discuss a survey sent to (a) 52 of the state's largest employers, (b) all 29 counties, and (c) 112 first-, second-, and third-class cities. The survey examines how counties, communities, and businesses in Utah view their level of awareness of earthquake safety and the priority they place on earthquake safety, given the relative seismic risk where they are located.

Finally, taking into account the results of the survey described in Appendix E, we outline our plans for future initiatives, priorities, and activities for the Commission.

### **KEY ISSUES AND ACTIONS**

#### SEISMIC SAFETY IN SCHOOL CONSTRUCTION

#### STRATEGIES ADDRESSED

3.1 — Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.

#### **ACTION**

At its second quarterly meeting of 1997, the Commission heard from the Engineering and Architecture Standing Committee (EASC) on proposed legislation that would have required state licensing of building-plans examiners. As an illustration of the problems inherent in the existing system, the EASC said no more than 10 percent of the 40 school districts in the state use licensed building inspectors, whose primary responsibility is to make sure the construction is being done according to the plans, not if the structure complies with building codes generally or seismic-safety requirements specifically.

When the report was published in a daily newspaper, the reaction from school districts was immediate. A contingent from the four largest districts in Utah asked to be allowed to respond at the next quarterly meeting of the Commission, on July 2, 1997. A spirited discussion ensued, with the school officials maintaining that their process adequately addressed the concerns of seismic safety. The Commission proposed that the EASC specifically and the Commission in general participate in a continuing dialogue with school districts to find out whether current practices of design, plan-checking, and inspection of new school construction in Utah posed an earthquake-safety issue. The intended outcome of this voluntary discussion would be to determine whether there is a process in place to ensure safe schools in Utah and, on a larger scale, whether there is concern for the structural safety of all buildings in Utah.

At the fourth quarterly meeting of the year, the EASC reported back that (1) the larger issue of building safety throughout Utah was an ongoing concern and (2) there was a need to review school construction designs later in the design process than is currently being done. The latter issue was to be directed to the State Office of Education to resolve through administrative rulemaking rather than attempt to accomplish any sort of legislative mandate.

At the second quarterly meeting of 1998, the EASC reported on a meeting with the State Superintendent of Public Education regarding the issue of "improved plan review" for school construction within the State of Utah. The Superintendent encouraged the EASC to submit written recommendations for consideration by his office.

By October 1998, a proposal which had been reviewed by representatives from the Granite, Davis, and Salt Lake school districts was submitted by the EASC to the State Office of Education. The proposal called for additional structural review by a licensed structural engineer at the 90-percent completion phase of design for new school construction. As a means of reducing the costs and the time involvement for this second review, it was proposed that it be performed by the same structural engineer who took part in an early-stage "value engineering session."

#### **OUTCOME**

The State Board of Education (SBE) adopted Rule R277-471, "Oversight of School Inspections," in the summer of 1999. The rule became effective November 2, 1999, and has the same authority as statute. At the same time, the State Office of Education (SOE) published the "School Building Construction and Inspection Resource Manual," and the new Rule specifies that the SBE, local school boards, and school district personnel shall act consistent with the Manual.

The Manual stipulates that a licensed structural engineer shall perform a value-engineering review of school plans and specifications at the 90-percent completion stage in buildings where costs exceed \$300,000. The review "will focus primarily on the lateral load resisting systems and details."

The SOE requires that all new school construction and major additions to existing facilities located in regions of moderate to high seismic risk (Zones 2B and 3) be subject to this procedure.

#### PREPARED SCHOOLS

#### STRATEGIES ADDRESSED

- 1.1 Inform citizens about earthquake hazards and risks.
- 1.2 Incorporate earthquake education in school curricula.
- 3.3 Improve the post-earthquake operational status of essential service buildings.
- 3.6 Improve safety and operation ability of older public school buildings.
- 5.1 Update estimates of direct losses to be expected from earthquakes.
- 5.2 Evaluate the indirect losses associated with earthquakes.

#### <u>ACTION</u>

The Awareness and Education Standing Committee (AESC), through its Schools Subcommittee, undertook a survey of public and private schools in Utah. The survey was mailed in April 1998 to 731 public school and 102 private school principals. Of that total, 365 public schools (49.9 percent) and 25 private schools (24.5 percent) responded. The purpose of the survey was to learn what has already been done in schools to prepare for emergencies and in what areas help is needed to become better prepared. During the course of the survey, the AESC's School Subcommittee succeeded in gaining Governor Mike Leavitt's endorsement on a proclamation designating April as "Earthquake/Disaster Preparedness Month," which enhanced public awareness of earthquake safety issues.

The responses to the survey indicated that the majority of Utah school principals, both public and private, have an interest in being well prepared for emergencies. Most (94 percent public, 76 percent private) have written plans and all responding schools hold at least one fire drill annually; most (83 percent public, 76 percent private) hold earthquake drills at least once a year, and fewer (50 percent public, 38 percent private) hold drills for other emergencies at least once a year. Even fewer (48.2 percent public, 40 percent private) have ever evaluated their plans, although most (87.4 percent public, 72 percent private) review it at least once every one-to-three years.

When asked specifically about earthquake risk, the respondents produced fewer positive responses. While most schools identified some or all of the nonstructural hazards, such as furnishings that could fall (77 percent public, 92 percent private), far fewer have in place a plan to mitigate these same hazards (59 percent public, 64 percent private). Many of the responding principals did not know whether their buildings had been inspected by structural engineers for earthquake resistance (64 percent public, 48 percent private).

Public schools usually have Parent-Teacher Associations that are active in safety issues (76 percent), and about half of all responding schools recognized that they could use some help in becoming better prepared. Most wanted help with writing emergency plans (52.5 percent public, 50 percent private) and receiving grade-level specific activity packets (57.2 percent public, 75 percent private). Fewer than half wanted how-to workshops on writing plans, conducting drills and exercises, educating school communities, and identifying and mitigating non-structural

hazards (43.1 percent public, 41.6 percent private); or CERT training (45 percent public, 37.5 percent private).

A major concern of the survey was with the preparedness of schools that did not reply. Were they statistically similar to the respondents, or did they choose not to participate in the survey because they had very little — or no — interest in earthquake preparedness issues?

The AESC is now using the school surveys to develop a "Prepared Schools Project," a plan to encourage and aid all schools to become better prepared for emergencies in general and earthquake hazards in particular. The project takes schools incrementally through two levels of preparedness, helping them reach the highest standard of readiness.

To assist schools with the "Prepared Schools Project", the AESC developed a "Certificate for Effective Drills and Safe Surroundings," which requires schools to complete four simple tasks: (1) conduct a school-wide earthquake/disaster drill, (2) have the school safety committee evaluate the drill, (3) conduct a school-wide hazard hunt, and (4) conduct the required number of fire drills during the school year. To assist with these tasks, the AESC provided all schools with a binder of activities, curriculum materials, a disaster video, maps, and posters. Once they earn that certificate, schools will then need to demonstrate competency in five areas: (1) awareness and education, (2) reducing risks before the event, (3) emergency response, (4) longer-term emergency response, and (5) recovery.

Another step in preparing schools was the School Safety Plan Bill passed during the 2000 Legislative Session. The Bill, H.B.14, sponsored by Representative Patrice Arent, requires schools to have a comprehensive plan as it relates to school violence. However, most school administrators are taking this opportunity to develop all-hazards school safety plans.

One of the obstacles to the program, according to school administrators, is accomplishing those tasks without detracting from budgeted time for instruction and activities. An example of how schools can make earthquake safety part of the learning curriculum was demonstrated in 1999 by Pleasant Grove High School (PGHS) in Utah County. Administrators used the existing Schools-to-Careers Program at PGHS to stage an earthquake preparedness drill that involved the entire 1,500-person student body, which was able to work with professionals from the local hospital and fire department, police and sheriff's agencies, ambulance companies, local government, newspapers, and radio stations.

As an added bonus, students in the Health Education Academy Program gained experience in triage efforts and first aid, while students in the Drama Department used their make-up skills to make the "injured" students looked realistic. Everybody had a role, and the school even used the drill to have the school district evaluate the building itself, which was constructed in 1959.

PGHS has an evacuation plan in place, and the exercise tested it as well as showing school officials how their plan interfaced with plans of local hospitals, city and county governments, and

police agencies. The drill tested evacuation and transportation capabilities by using ambulance companies, school buses, and even Utah Army National Guard paramedic vehicles.

By using a concept known as "job shadowing," administrators were able to keep everybody interested. Students followed health-care providers, police officers, reporters, emergency medical technicians, and fire department personnel as they did their jobs in a stressful setting. The drill involved surrounding communities and, as a part of the curriculum, it can be refined and reused every year.

The School Subcommittee was recognized by the Western States Seismic Policy Council at the National Earthquake Risk Management Conference. The Subcommittee tied with the Washington Division of Emergency Management and the Nevada Seismological Laboratory for the National Award in Excellence for Educational Outreach to Schools.

#### **OUTCOME**

By emphasizing the need and demonstrating ways for schools to adapt their curricula to accommodate seismic safety, the Commission has made a real impact on parents, teachers, and school administrators by instilling awareness of an issue too easily overlooked. Tangible outcomes will begin to accrue when schools pass the requirements to become "Prepared Schools" and qualify for reductions in insurance premiums.

#### INVOLVING BUSINESSES AND INSTITUTIONS IN SEISMIC SAFETY PLANNING

#### **STRATEGY ADDRESSED**

1.1 — Inform citizens about earthquake hazards and risks.

#### **ACTION**

The Awareness and Education Standing Committee (AESC) planned and convened three conferences—in 1996, 1997, and 1998—as part of a strategic initiative to get businesses and institutions to more carefully consider seismic safety issues in their contingency planning efforts.

At the first conference, "Earthquakes in Utah: Will Your Business Survive?" the AESC made the Strategic Plan an integral part of the agenda. The conference attracted more than 200 participants to the State Office Building and presented Utah business people with the sobering realities of earthquake vulnerabilities.

The conference featured a scenario presentation and panel discussion on what would happen if a magnitude 6.7 earthquake struck Salt Lake City. Representatives from county government, emergency response agencies, insurance and financial institutions, engineering and construction industries, and public utilities discussed possible ways the earthquake would affect them the day of the event as well as one week, one month, and one year later. The conference-goers were left with an encouraging message: preparation saves lives, jobs, and businesses.

Breakout sessions focused on mitigation, emergency response, business recovery, and workplace and home preparedness. Attendees viewed video footage of earthquake damage resulting from the 1994 Northridge, California, event; heard detailed information on building construction for earthquake safety; received tips on how large and small companies address earthquake problems; and picked up tips on making their homes earthquake safe.

The conference concluded with a presentation of the USSC Strategic Plan and the reminder that motivation for improving earthquake safety usually comes from private groups and local governments.

The AESC followed up a year later with another successful conference, "Earthquakes: Mean Business." The emphasis for this conference was on business survivability issues, and the 1994 Northridge, California, earthquake served as a model for a team of researchers who interviewed business owners one and two years after the event. Business representatives discussed the components of a recovery plan, including the ability to:

- Respond to the new market dynamic by changing strategy and tactics, while being realistic in assessing capabilities and options. If a new location is needed, for example, do it without delay and get the word out; do not simply wait for customers to return.
- Maintain adequate cash reserves and insurance to cover potential damage.

- Know the terms of the lease and the responsibilities contained in it.
- Prepare for recovery delays; it takes time to restore infrastructure and community services.
- Take the extra steps needed to protect business records, both paper and electronic copy.

The message to businesses was clear: think about more than just bricks and mortar. For businesses to survive an earthquake, structural mitigation efforts must be met with management mitigation techniques.

The 1997 symposium also offered breakout sessions on the "employee lifeguard" program for remaining in business in spite of an earthquake, legal liability and insurance issues for employers, business and home preparedness measures, emergency response training, and workplace preparedness and survival techniques. More than 150 business leaders and government officials from the Wasatch Front attended.

In 1998, the AESC joined with the Utah Chapter of the Association of Contingency Planners (ACP) in sponsoring a symposium on preparing businesses and communities for surviving disasters. Presentations included breakout sessions on "How to Plan: The ABCs of Business Resumption Planning," "Plan Validation: Testing Your Plan in Small-Group Table-Top Demonstrations," and "All Hazards Preparation: A Broad-Scope Workshop on All Manner of Perils that can Affect Your Community." This conference attracted about 175 risk managers, contingency planners, and emergency preparedness officials from throughout the state.

Recognizing the value of an ongoing partnership with the Utah Chapter of the ACP, which has many active members from the business sector and major institutions, efforts were made by the Commission, beginning in late 1999, to add a representative from ACP as a formal member of the Commission.

#### **OUTCOME**

The three earthquake-awareness conferences attracted more than 500 representatives from communities, businesses, and institutions; received prominent coverage in Salt Lake City's major daily newspapers and television news stations; disseminated volumes of reference material and self-help guides; and helped raise the public's awareness of seismic safety concepts, concerns, and solutions.

Under an amendment to the Utah Seismic Safety Commission Act, passed in the 2000 General Session of the Legislature (see Appendix B), a representative from the Utah Chapter of the Association of Contingency Planners, biannually selected by its membership, was added to the Commission.

# RECOGNIZING EFFORTS OF BUSINESSES, GOVERNMENTS, SCHOOLS, AND INDIVIDUALS TO IMPROVE SEISMIC SAFETY IN UTAH

#### STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.

#### **ACTION**

During the earthquake awareness conferences that the Awareness and Education Standing Committee planned, coordinated, and carried out in 1996 and 1997, select businesses, institutions, and individuals were recognized for their efforts in promoting seismic safety in Utah.

At the 1996 conference, Lt. Gov. Olene Walker presented the first USSC Earthquake Safety in Utah Award to the *Salt Lake Tribune* and its Science Writer, Lee Siegel. The citation noted that the morning daily reported on earthquake-related activities in Utah and made an important contribution to increasing awareness and promoting earthquake safety among Utah's citizens, businesses, and decision-makers. Siegel spearheaded the reporting of earthquake issues, and his editors featured those reports and other earthquake-related articles prominently and supported earthquake safety.

The first Certificate of Excellence was awarded to Brigham Young University for its comprehensive campus-wide and community-wide earthquake safety efforts, including (1) providing earthquake awareness and preparedness information to all students and staff, (2) providing Community Emergency Response Teams (CERT) training for 118 employees, (3) developing an emergency communications system and comprehensive disaster-response plan, (4) maintaining 72-hour food and water supplies for all students, and (5) creating an on-going seismic upgrade plan for existing facilities.

The second Certificate went to the Salt Lake City School District for its pioneering efforts and initiative in upgrading older schools and improving earthquake safety. The district was the first in Utah to commission a district-wide evaluation of its buildings. Based on those findings, the district implemented a plan to retrofit and replace the schools that need upgrading.

The third Certificate went to Hyde Park City for involving its community in disaster planning, providing CERT instruction, holding mock disaster exercises, replacing or relocating city offices and water-system components to safer structures and locations, and including seismic hazards in its master plan and zoning ordinances.

At the 1997 conference, two organizations were recognized for their mitigation efforts. The USSC gave its Award for Outstanding Contributions to Earthquake Safety in Utah to Mountain Fuel Supply Company for its efforts to provide awareness and safety information to all its employees and customers. Mountain Fuel conducted company-wide earthquake response

exercises, was involved in a long-term program to upgrade its distribution lines and facilities to improve earthquake resistance, and exceeded building code requirements in its new facilities.

The Utah Department of Transportation received the Certificate of Excellence for implementing a state-of-the-art seismic design of the Interstate 15 reconstruction project. The criteria exceeded code requirements and were designed to help ensure the survival of this critical roadway even in the event of the strongest ground shaking expected.

#### **OUTCOME**

The Commission, together with its goals and objectives, was featured prominently in the two major daily newspapers in Salt Lake City and on the local television news channels, thus raising the awareness of state and regional residents to the issue of seismic safety.

# RECOGNITION OF EFFORTS BY COMMISSION STAFF TO ADVANCE EARTHQUAKE EDUCATION AND AWARENESS

#### STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.

1.2 — Incorporate earthquake education in school curricula.

#### **ACTION**

The three organizations that are the foundation of the earthquake program in the state have received regional and national recognition of their programs in education and awareness.

The University of Utah Seismograph Stations' Earthquake Education Services (EES) outreach effort encouraged earthquake science and safety instruction in Utah schools by meeting teachers' needs for activities, materials and workshops. Its "Earthquakes in the Utah Core Curriculum" project received funding from FEMA. The project brought teachers and geologists together to develop grade-level-appropriate lessons and hands-on activities in grades 3, 5 and 9. The teacher/geologist teams traveled to individual school districts to instruct teachers and distribute activity packets and teaching materials. As the result of popularity of this program, CEM's Earthquake Preparedness Information Center (EPICenter) has provided three additional years of funding to continue the teacher workshops.

EES also compiled information on 48 damaging earthquakes that have occurred in the Intermountain West in the past 70 years, using that information to produce "Earthquakes in the Intermountain West," a traveling exhibit of photographs, text, and graphics. The exhibit was developed with funding from the National Earthquake Hazards Reduction Program (NEHRP) through the U.S. Geological Survey (USGS). The target audience is the general public and school communities. The 8-foot by 19-foot free-standing display has been placed in libraries, government buildings, small museums, and earth-sciences conventions.

The demand for the display was so great that a second one was purchased by the EPICenter. The Utah State PTA and the EPICenter have provided funding for travel and shipping costs for the displays which have traveled not only throughout Utah, but have been sent to Idaho, Montana and Wyoming. EPICenter also provides maintenance funding for the displays.

CEM's Earthquake Preparedness Information Center (EPICenter) published "The Utah Guide for the Seismic Improvement of Unreinforced Masonry Dwellings." The publication fills a need for information dealing with unreinforced masonry homes and the means by which to seismically retrofit them. It also provides homeowners, engineers, and general contractors with guidelines to assist in seismic retrofitting activities.

The UGS's Geologic Extension Service produced a series of maps and brochures that detail the earthquake hazards and risks in Utah. The series was written for the general public, real estate

agents, and public officials and was distributed at scientific conferences, teachers' workshops, and state and county fairs.

As mentioned previously in the Prepared Schools portion of this report, the USSC's School Subcommittee developed a certificate for "Effective Drills and Safe Surroundings" for schools. This program received national recognition recently at FEMA-sponsored conference in Seattle.

#### **OUTCOME**

The EES, EPICenter, and UGS were recognized by the Western States Seismic Policy Council (WSSPC) at their 1997 Annual Conference in Victoria, B.C. The EES effort was a co-winner with the California Seismic Safety Commission's Seismic Retrofit Practices Education Program, of the Award for Overall Excellence and won the Award of Excellence in Outreach to Schools. The CEM brochure won the Award for Excellence in Mitigation Efforts, and the UGS initiative won the Award for Excellence in Outreach to the General Public.

The USSC's School Subcommittee was a co-winner with the Washington Division of Emergency Management and the Nevada Seismological Laboratory for WSSPC's National Awards in Excellence 2000 for Educational Outreach to Schools.

#### BUILDING-CODE ENFORCEMENT AND PLAN REVIEW

#### STRATEGIES ADDRESSED

- 3.1 Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.
- 4.4 Ensure design professionals and building officials are kept current on relevant geoscience information.

#### <u>ACTION</u>

In July 1996, the Engineering and Architecture Standing Committee (EASC) prepared a White Paper on building-code enforcement and plan review and presented it to the Utah Advisory Council on Intergovernmental Relations (UACIR). The proposal included suggested amendments to state law regulating the qualifications of building officials and plans examiners. The proposed changes also required all funds collected as a surcharge on building permits to be used solely for the purpose of code education and training.

The Commission noted in its White Paper that, although building code enforcement has improved in Utah over the past decade, serious deficiencies still exist. As a result, there are inequities for owners, builders, and citizens in general—including varying costs of construction from one jurisdiction to another, varying insurance rates from one city or county to another, under-regulation, and over-regulation. The solutions proposed by the Commission would include:

- Depositing all building permit revenues in a dedicated, non-lapsing fund.
- Establishing a regional or statewide agency that would provide assistance to local jurisdictions in meeting the objective of providing a full-service inspection program, to include quality control audits, special inspection coordination, code development, approved fabricator programs, support for absenteeism/overload circumstances, plan review for complex structures, engineering review, training, and maintenance of a technical library. The agency would be funded from the revenues derived from building permits.
- Appointing a state building codes administrator or building official to serve as technical support to the Uniform Building Code Commission (UBC) and to coordinate training needs.
- Creating minimum standards of competence for building officials and plans examiners.
- Ensuring that all state and school buildings would be accorded the same high level of examination and inspection as any other construction project, as provided for by the proposed legislation.

State Senator Craig Peterson, who represented the Senate on the Commission, sponsored the legislation as Senate Bill 135 in the 1997 General Session of the State Legislature. The measure received the support of the UACIR and the Inspector Licensing Board of the UBC Commission, but was opposed by the Utah League of Cities and Towns because of the funding issue.

#### **OUTCOME**

Senate Bill 135 passed the Senate by a comfortable margin but was narrowly defeated in the House during the 1997 General Session of the State Legislature. The EASC, with the support of the UBCC, then carried the issue to the Division of Professional Licensing (DOPL) in an attempt to get the rules changes incorporated into the State Inspector Licensing Law. That effort is ongoing.

#### SEISMIC STRENGTHENING OF EXISTING BUILDINGS

#### STRATEGIES ADDRESSED

3.1 — Enforce the state amendment to the Uniform Building Code which requires building building owners to install roof anchors and parapet bracing when reroofing their buildings.

3.8 — Improve the safety of older high-occupancy buildings (250 persons or more) to be structurally competent enough to withstand moderate to large earthquakes

#### **ACTION**

A fundamentally important way to promote earthquake safety in Utah is to reduce the number of seismically dangerous buildings within the state. It has long been recognized that unreinforced masonry buildings, referred to as URMs, are a major life-safety hazard in an earthquake, and this type of construction was common in Utah until about 1970.

At the Commission's April 1999 meeting, Commissioner James Bailey, a structural engineer, proposed that the Commission advocate a statewide ordinance, similar to ones successfully enacted in Seattle, Portland, and numerous jurisdictions in California, that would mandate when and how much retrofit was needed when an existing, non-residential URM building was remodeled. An ongoing process ensued informally termed the "existing building initiative."

In May 1999, the Commission asked the Structural Engineers Association of Utah (SEAU) for guidance as to the need for a statewide "existing building ordinance." Should regulation be advocated for the seismic retrofitting of certain classes of existing buildings in Utah—given the accelerating growth and development in seismically dangerous parts of the state? In response, the Seismic Committee of SEAU formulated a White Paper entitled, "Seismic Strengthening of Existing Buildings," dated July 8, 1999.

At a meeting of the Commission on July 9, 1999, Ken Willmore, chair of SEAU's Seismic Committee, presented the recommendations of his organization. A draft resolution approved by the SEAU board supported the need for regulations regarding the seismic retrofitting of existing buildings. The resolution suggested which actions should trigger the seismic upgrade of certain buildings, suggested existing documents to be used as guidelines for establishing a statewide code, recommended minimum seismic forces to be addressed by the code, and recommended the use of tax breaks and reduced insurance rates as incentives to make seismic upgrading attractive to building owners.

On July 14, 1999, the Commission wrote to the Uniform Building Code (UBC) Commission urging the adoption of the Uniform Code for Building Conservation (UCBC 2000) for the state of Utah and recommending that the UBC Commission take steps to ensure the enforcement of an existing statewide amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings. Adoption of the UCBC

2000 code would require and enforce at least a partial seismic upgrade when URM buildings in Seismic Zone 3 have their lives extended through major remodeling.

Representatives of the Commission appeared before the UBC Commission on August 20, 1999, and again on March 17, 2000, to advocate the requests described above. At the August 1999 meeting, the UBC Commission declined to take immediate action, citing potential costs and the need to build widespread political support. Instead, the UBC Commission members unanimously voted to announce their intent to consider adoption of the code and encouraged stakeholders to speak out on the issue. At the March 2000 meeting, faced with legal and other complications that confounded simple adoption of the UCBC Code, the UBC Commission referred the matter to its Structural Advisory Committee—encouraging a continuing partnership with USSC and SEAU in order to prepare further recommendations and to pursue educational outreach for promoting awareness of the existing "parapet" ordinance.

#### **OUTCOME**

In September 2000 the Uniform Building Code Commission passed a resolution recommending "that local jurisdictions within the State of Utah consider adoption of 'The Uniform Code for Abatement of Dangerous Buildings—1997,' 'The Uniform Code for Building Conservation—1997,' and 'The Guidelines for Seismic Retrofit of Existing Buildings—2000'." The process continues of attempting to enact formal statewide adoption of such codes—beyond simply recommending their local adoption.

Also in September 2000, a committee consisting of representatives from the Structural Advisory Committee of the UBC Commission, SEAU, and USSC published a brochure, "Earthquakes and Roofing—What You Need to Know About Seismic Bracing When Reroofing an Existing Building." The brochure describes the "Utah Parapet Ordinance" and its implications and is being actively used in a statewide educational campaign.

#### SEISMIC VULNERABILITY OF STATE BUILDINGS

#### STRATEGIES ADDRESSED

- 3.3 Improve the post-earthquake operational status of essential service buildings.
- 3.4 Reduce structural hazards of government-owned buildings.

#### **ACTION**

In September 1996, the Commission presented a request to the Utah State Building Board (USSB)—similar to a high-priority request made by the Commission one year earlier to the Governor—that \$10.5 million be added to the annual budget of the Division of Facilities Construction and Management (DFCM) in order to assess the seismic vulnerability of state buildings and to begin to retrofit those in most critical need.

The USSB subsequently gave the request a high priority and forwarded it to the Governor's office for inclusion in the fiscal year 1997-1998 budget. However, the requested funds were not included in the Governor's final budget recommendation for that year.

At the Commission's quarterly meeting in October 1999, Commissioner Matthias Mueller of DFCM summarized DFCM responsibilities for enforcing construction standards, including those for seismic safety, in state buildings. Code requirements, supplemented by DFCM design criteria, are implemented in the design of every new state facility, and a team of licensed inspectors from DFCM inspects state construction projects to ensure code compliance.

Mueller outlined results of a survey of 193 older state buildings indicating that 111 of the 193 buildings surveyed by that date needed structural upgrading. Buildings which had already undergone seismic and other upgrades included the Utah Industries for the Blind, Utah State University's Old Main building, Weber State University's Browning Performing Arts Center, the Governor's Mansion, the University of Utah's Kingsbury Hall, Snow College's Noyes Building, and Salt Lake Community College's Grand Theater.

According to Mueller, DFCM assumes that approximately 51 percent of state-owned buildings comply with the Uniform Building Code because they were constructed after the code was first implemented in 1974. Commissioner James Bailey noted that buildings constructed between 1974 and 1985 should not be presumed to comply with the code because quality control then was not as stringent as current practice.

#### **OUTCOME**

Despite the Commission's unsuccessful attempt in 1996 (and earlier in 1995) in advocating dedicated state funding for progressively remediating the seismic vulnerability of older state-owned buildings, progress is being incrementally made in seismically strengthening selected

buildings as part of major remodeling projects. Standards for seismic safety of new state facilities are routinely enforced by DFCM.

During the fiscal year 2000-2001, an amount of \$36.7 million was appropriated to DFCM for improvement projects—separate from capital development projects—which will enable some seismic upgrades (e.g., seismic bracing when reroofing). Some of the capital development projects also include seismic upgrades.

#### THE SAFETY OF CONSTRUCTION IN DOWNTOWN SALT LAKE CITY

#### STRATEGIES ADDRESSED

- 1.1 Inform citizens about earthquake hazards and risks.
- 4.1 Reduce earthquake losses by mapping and identifying geologic hazards.
- 4.3 Make land use compatible, through local government ordinances, with known hazards.
- 4.4 Ensure design professionals and building officials are kept current on relevant geoscience information.

#### **ACTION**

In 1998 and 1999 the Commission served as a sounding board and forum for concerns about fault-displacement hazards associated with active faults in the Salt Lake City metropolitan area. In 1997 Salt Lake County published a new version of its geologic hazards map, basing the depiction of active faults on a 1992 map produced by the U.S. Geological Survey. Unfortunately, Salt Lake County's 1997 map differed significantly from its earlier 1989 geologic hazards map, which showed that a branch of the Wasatch fault, known as the Warm Springs fault, may trend through downtown Salt Lake City approximately along West Temple.

As a consequence, several downtown projects were approved by Salt Lake City without the requirement to perform special studies for surface fault-rupture hazard.

Craig Nelson, Salt Lake County geologist at the time, brought the matter before the Commission in January 1998 after an investigative piece in a local newspaper revealed the discrepancy. He described efforts he had begun that would develop consistent standards for the County to follow in order to ensure a minimum acceptable scope-of-work and independent review of any geotechnical report prepared for developers. His plan would require all consultants to use the same map—the 1989 one—until a newer one could be prepared that showed the existence of the Warm Springs fault trend.

He also proposed to create a geologic review board to consider and approve all changes to the 1989 map and to hear any appeals of the county geologist's recommendations. The 1989 map would be made available through the Internet to improve the quality of information used for development and ensure a consistent set of standards with respect to seismic safety issues.

In early 1999 the issue of whether there was an active fault beneath the downtown area was raised again when contractors working on the Salt Palace Addition outlined for the Commission, at its January quarterly meeting, some evidence suggesting that a fault may indeed run directly through the site in a north-to-south trend consistent with the 1989 map projection.

Kenneth Ament, president of the construction company working on the addition, said his company addressed the potential for a fault on the site before beginning construction by drilling

12 boreholes into Lake Bonneville sediment, about 60 feet below the grade of 2nd South. The addition was designed to include an underground parking structure and an exhibit hall above.

The drilling revealed no evidence of a fault, but because of the difficulty in trenching posed by existing structures, the geotechnical report on the site recommended instead the inspection of cuts as excavation progressed. At 23 feet below the grade of 2nd South, the contractors uncovered geologic features that showed tectonic characteristics. They dug three trenches to provide a clearer view of the features and notified the state and county.

Initial indications were that the features were caused either by tectonic faulting or by liquefaction, which is not tectonic in nature. Work was suspended for 30 days to do more trenching closer to the existing Salt Palace structure to study the evidence more closely and to perform carbon dating on the deposits.

One consultant's conclusion was that the features uncovered were evidence of an extension of the Warm Springs fault, which manifests as a 30-foot downdrop just one mile north of the Salt Palace. Geologists have speculated that the Warm Springs fault could run as far as 4th South along the same line. Another consultant's conclusion was that the features resulted from liquefaction-induced lateral spreading.

Geologists examining the trenches said they showed sand dikes characteristic of liquefaction and displacement vertically, producing a graben—which represents pulling apart.

#### **OUTCOME**

Nelson resigned as Salt Lake County Geologist soon after his presentation to the Commission, and Darlene Batatian, the new Salt Lake County Geologist, continues to further his initiative. Salt Lake County submitted its contradictory consultants' reports on the Salt Palace to Salt Lake City. After obtaining a third-party review of the reports, Salt Lake City accepted the finding that the features were liquefaction-induced and permitted the project to continue. The contractor redesigned the foundation footings to accommodate the possibility of minor movement and resumed work on the structure, which is expected to be completed by the summer of 2001 in time for a major trade show. The facility will also serve as the main media center for the 2002 Winter Olympic Games. Factions within state and local government politicized the debate about whether the features represented an active fault or merely liquefaction. Consultants made equally compelling, but contradictory scientific presentations at the Association of Engineering Geologists annual meeting in Salt Lake City in October 1999.

# VULNERABILITY OF THE STATE'S LIFELINES, INFRASTRUCTURE, AND WATER AND WASTEWATER SYSTEMS

#### **STRATEGIES ADDRESSED**

- 3.12 Improve lifeline survivability in the event of an earthquake.
- 3.13 Improve earthquake performance of water and waste-water systems.
- 4.6 Reduce earthquake-induced liquefaction risk to highway structures.
- 4.7 Determine appropriate seismic design coefficients for highway bridges.
- 5.3 Conduct lifeline collocation vulnerability studies.

#### **ACTION**

The Lifelines and Infrastructure Standing Committee (LISC) began creating in 1998 a GIS-based inventory of all the important lifelines in Utah, including transportation routes and utility corridors, with a primary focus on the Wasatch Front area. The committee is also studying the issue of collocation of utilities, a situation that tends to magnify damage to lifelines during earthquakes.

The Lifelines Committee of the American Society of Civil Engineers (ASCE) conducted a survey in 1995 of Utah's approximately 300 water-system groups and 150 sewer-system groups regarding their knowledge of earthquake vulnerability. From that information, Mr. Carl Carpenter, a former member of ASCE's Water and Sewer Technical Committee, identified the need for basic education and developed a presentation to show those groups how to evaluate their own systems. In March 1998, Mr. Carpenter volunteered to make this presentation, under the auspices of the Commission, to operators of water and wastewater systems throughout Utah.

#### **OUTCOME**

The Commission agreed to fund further presentations by Mr. Carpenter and to help update the information with the latest data on water and wastewater systems in Utah.

The compilation of a GIS-based inventory of critical lifelines in Utah is continuing—in part, under combined efforts with the Utah Division of Comprehensive Emergency Management through the implementation of Hazards United States (HAZUS), a GIS-based software program for assessing vulnerabilities of the built environment to earthquakes and other hazards.

Members of the Commission are also actively involved on the Infrastructure Protection Subcommittee of the Utah Olympic Public Safety Command, whose efforts are aimed at making Utah's critical infrastructure disaster-resistant before, during, and after the 2002 Winter Olympics.

#### INTERSTATES 15 AND 80 BRIDGE RECONSTRUCTION

#### STRATEGIES ADDRESSED

- 3.12 Improve lifeline survivability in the event of an earthquake.
- 4.6 Reduce earthquake-induced liquefaction risk to highway structures.
- 4.7 Determine appropriate seismic design coefficients for highway bridges.

#### <u>ACTION</u>

Attention to improved seismic safety for Utah's highway bridges and structures was a key part of the Commission's 1995 strategic plan, and individual members of the Geosciences Standing Committee (GSC) have been actively involved in advancing that safety. Prior to the \$1.59 billion I-15 reconstruction project, the Utah Department of Transformation (UDOT) estimated that half of the Salt Lake Valley's deteriorating freeway bridges would collapse if a major earthquake hit the area.

In 1996, four members of the GSC served on an I-15 Corridor Seismic Advisory Committee to assist UDOT in establishing seismic design criteria and in reviewing and advising on the acceptability of earthquake-related studies and design recommendations made by I-15 consultants. The committee was instrumental in persuading UDOT to use design standards for the project that were higher than those it conventionally uses, so that freeway bridges would not collapse, but at most sustain repairable damage during a large earthquake on the Wasatch fault.

Following its attention to the seismic design of I-15 highway bridges and structures, UDOT cosponsored a technical conference in January 1999 to address the problem of seismic retrofit of its highway bridges elsewhere in the state. Attention notably turned to aging highway bridges on I-80 between State Street and Parley's Canyon that posed potential losses of \$170 million—and acute disruption of transportation—if hit by a magnitude 7 earthquake. Partial reinforcement of the 25 freeway bridges on that stretch of I-80 was scheduled to begin in the summer of 1999 to help keep those bridges operational for 15 years until they could be rebuilt completely.

Researchers at Utah State University and the University of Utah are conducting studies on old highway structures that were torn down during the I-15 reconstruction process. These old bridges and overpasses have become experimental devices that structural engineers use to determine if various shaking techniques can reveal structural damage in a bridge. The ability to use the condemned bridges gives the researchers information they can compare to results from national laboratories on the behavior of steel girders—information that cannot adequately be acquired in any other testing environment.

A research team from Brigham Young University is investigating the earthquake resistance of steel pilings used on the I-15 project, using a form of seismic testing known as static and

statnamic loading, to study how the pilings will hold up under the estimated stresses of an earthquake.

#### **OUTCOME**

Seismic design standards were used in the I-15 reconstruction project that significantly exceed minimum national highway standards, ensuring that the I-15 bridges will withstand the strongest earthquake shaking expectable without collapse. Damage that may be sustained will be repairable so that the bridges can be returned to service relatively quickly. In the case of reinforcing aging highway bridges on I-80 between State Street and Parley's Canyon, potential losses of as much as \$170 million due to a magnitude 7 earthquake will be reduced to about \$17 million, thanks to selective seismic retrofitting. Ongoing research by university scientists and engineers will allow engineers to ensure the earthquake safety of highway bridges in Utah in a cost effective way without over-building structures.

#### FUTURE NEED—AN EVALUATION OF UTAH'S TRANSPORTATION LIFELINES

While new facilities are designed and constructed to a higher level of seismic resistivity than in the past, much of Utah's transportation system was constructed prior to the development of modern seismic codes and engineering practices. It is important to identify the seismic vulnerability of the state's transportation lifelines. While the emphasis will be on State owned facilities, this exercise should also include city and county facilities as well.

The first step should be to determine the transportation lifelines that will become critical after a major seismic event. The effort should focus on routes adjacent to hospitals, fire stations, schools, the airport, etc., and requires local and regional planning input. Next, an evaluation of the bridges along the critical lifelines will need to be evaluated for seismic vulnerability. Bridges determined to be seismically vulnerable should be identified and prioritized. At a minimum, this information can be used by bridge owners when performing rehabilitation work on critical lifeline bridges. At a maximum, the information can be used to develop long range seismic retrofit strategies for Utah's bridges. UDOT has planned a research project to perform all or part of this evaluation including prioritizing, but as of now it is unfunded. The USSC will provide information regarding the limited work that has been accomplished in this endeavor, so the UDOT research effort can build on what has been accomplished to date. The USSC will also provide oversight and support as requested by UDOT.

# LOCAL GOVERNMENT NEEDS FOR GEOSCIENCE INFORMATION AND TRAINING TO REDUCE RISKS FROM EARTHQUAKES AND OTHER GEOLOGIC HAZARDS

#### STRATEGIES ADDRESSED

- 4.1 Reduce earthquake losses by mapping and identifying geologic hazards.
- 4.2 Perform geologic hazards investigations for critical public facilities.
- 4.3 Make land use compatible, through local government ordinances, with known hazards.
- 4.4 Ensure design professionals and building officials are kept current on relevant geoscience information.

#### **ACTION**

In 1999, the Geoscience Standing Committee (GSC) and the Utah Geological Survey (UGS) established the Guidelines Advisory Committee (GAC) to determine what products and services would be needed, who should provide them, and what resources might be required by local governments. The GAC also addressed possible roles of local government insurers — Utah Risk Management Mutual Agency (URMMA) and Utah Local Governments Trust (ULGT) — in encouraging risk reduction.

The Commission relied on some investigational and educational priorities of the University of Utah Seismograph Stations (UUSS), the Division of Comprehensive Emergency Management (CEM), and the Applied Geology Section and Geologic Extension Service of the UGS in dealing with this issue. Other organizations involved in furthering the initiatives of the Commission include the Utah Department of Transportation (UDOT), Utah State University (USU), and Brigham Young University (BYU).

The GAC identified the following local government groups as having specific needs for geoscience information:

- planners, who work directly with developers, landowners, and geotechnical consultants in regulating land use;
- building officials, who perform field inspections of sites, and in some rural jurisdictions, perform all of the duties of city/county engineers and planners; and
- elected officials and administrators, who must be informed of the dangers to citizens in their jurisdictions posed by geologic hazards to help them implement appropriate risk-reduction measures.

The GAC identified the products and services needed by each of those groups, the likely preparers of the information, possible sources of funding, and steps needed for implementation.

Planners use geoscience information to prepare, adopt, and enforce ordinances and prepare master plans that reduce losses from geologic hazards. Planners should understand hazards and

be able to inform developers and landowners of studies required prior to approval of subdivisions or other land uses. The earth-science information products most valuable to planners, listed in order of priority, are:

- Special-study-area maps showing where geologic hazards may exist. These maps are chiefly for use in ordinances to indicate where special studies are required and possibly for disclosure in real-estate transactions. They would be prepared by the UGS, county geologists, or private consulting geologists. The UGS and local governments would share funding while consultants would be eligible for direct funding. In order to provide this product, the preparers would complete new maps and update existing maps, and conduct workshops in the use of geologic-hazards maps in ordinances and for disclosure.
- Non-technical brochure(s) explaining hazards and risk-reduction measures that planners can hand out to developers and homeowners; training for planners to better understand geologic hazards and risk reduction; compilations of individual packets of information specific to a city or county. The preparers would be the UGS, county geologists, and UUSS's Earthquake Education Services. No outside funding has been identified; possible contributions could come from cities and counties for specific information packets. The new brochures would cover all geologic hazards, and the preparers would more widely distribute those already available and provide workshops and training for planners to increase understanding of geologic hazards and risk-reduction measures.
- A brochure explaining the process of using geologic-hazards information and maps, ordinances, and disclosure to reduce risks and losses. Preparers would be the UGS and county geologists. There has been no outside funding identified. Preparers would produce the brochure and distribute and train users, perhaps through the American Planning Association (APA), Utah League of Cities and Towns (ULCT), Utah Association of Counties (UAC), and URMMA.

Building officials must be able to recognize evidence for hazards in the landscape and in excavations. They must be familiar with seismic and grading requirements in the UBC. The Utah Chapter of the International Conference of Building Officials (ICBO) could present workshops and field training at its annual meetings, and the URMMA could host workshops and hold field trips for building officials in UBC requirements and field hazard recognition with help from the UGS and county geologists. Funding could come from the UBC Commission (Division of Occupational and Professional Licensing) education fund.

Elected officials and administrators need succinct, straightforward information on geologic hazards and the role that local government can play in reducing risk and liability. Workshops are impractical because elected officials often change every two years; information products most valuable to this group, listed in order of priority, are:

• A brochure discussing geologic-hazards liabilities and Utah case law affecting cities and counties, and ways to promote safety and reduce liability. The preparers would be city/county attorneys, other legal council, or law-school students/faculty. Funding sources have not been identified, but the need could be met by encouraging and facilitating research by City/County attorneys or as a research project for law-school students/faculty.

• Analysis of costs and benefits of geologic-hazards risk reduction. The preparers would be the UGS, CEM, or the HAZUS Data Users Group. Funding sources have not been identified. HAZUS (see p.33) can produce loss estimates for earthquakes and other hazards. For all hazards, the need exists to compile historical losses, estimate costs of risk reduction, and compare actual and projected losses to risk-reduction costs to determine benefits.

URMMA and ULGT provide insurance coverage to their local government members. URMMA, in particular, promotes risk reduction by providing training and assigning ratings to local government members based on their risk-reduction efforts. URMMA could further help local governments manage risks from geologic hazards by including geologic hazards in their training workshops and risk ratings. The URMMA Executive Committee oversees risk ratings and would need to approve any proposed changes or additions to the rating system to include geologic hazards. Other groups highlighted by URMMA that need geoscience information to help encourage risk reduction include the ULCT, UAC, local Councils of Governments (county commissions and mayors in each county), URMMA itself, and ULGT. This information should include examples of risks taken and losses incurred by local governments from geologic hazards.

A need exists for geoscience information in a form designed for local government officials to use in promoting risk-reduction measures. Planners need maps depicting geologic-hazard special-study areas and information explaining hazards and the risk-reduction process. Building officials need training in UBC requirements and field hazard identification. Elected officials and administrators need information on local government liability and responsibility to protect public safety with respect to geologic hazards and the costs and benefits of risk reduction. Partnerships with various professional (APA, ICBO) and local government (ULCT, UAC, URMMA, ULGT) groups can greatly facilitate risk reduction.

Completion of these geoscience-information products and services becomes the responsibility of the designated preparers, as facilitated by the GSC and UGS. Because completion depends on factors outside the GAC's control, no time tables or schedules can be set for completing products or performing services.

In light of those needs, there have been several publications and technical studies produced by the UGS and others since July 1996, as well as new scientific and technical investigations involving the Applied Geology Section of the UGS and funded at least in part by the National Earthquake Hazards Reduction Program:

#### Non-Technical Publications

• The Wasatch Fault (PI-40), a brochure that explains the hazard the fault poses and gives examples of good and bad land uses in the fault zone, summarizes how often earthquakes occur on the fault, and discusses the potential for future activity. Several full-color photographs show what the fault is, where it is located, and how to recognize it.

- Earthquake hazard maps compiled by CEM of eastern Box Elder, Weber, Salt Lake, Davis, and Utah counties, showing critical facilities such as schools, hospitals, and dams, and locating liquefaction and surface-rupture hazards and landslides.
- The Homebuyers Guide to Earthquake Hazards in Utah (PI-38), a general-information pamphlet that discusses real estate concerns.
- *Earthquakes & Utah* (PI-48), a brief summary of seismic events that have affected Utah from Brigham City to St. George.

#### Technical Studies

- Surficial geologic map of the Nephi segment of the Wasatch Fault zone, eastern Juab County.
- Surficial geologic map of the West Cache fault zone and nearby faults, Box Elder and Cache counties.
- Paleoseismology of Utah, Volume 6: The Oquirrh fault zone, Tooele County, Utah: surficial geology and paleoseismicity.
- Paleoseismology of Utah, Volume 7: Paleoseismic investigation on the Salt Lake City segment of the Wasatch fault zone at the South Fork Dry Creek and Dry Gulch sites, Salt Lake County, Utah.
- Paleoseismology of Utah, Volume 8: Paleoseismic investigation at Rock Canyon, Provo segment, Wasatch fault zone, Utah County, Utah.
- Proceedings Volume, Basin and Range Province Seismic-Hazards Summit.

# Scientific and Technical Activities

- A paleoseismic study of the West Cache fault zone (WCFZ), Cache Valley, Utah, which is between Logan and Brigham City, Utah's tenth and 16th largest cities, respectively. The UGS has excavated and logged four trenches to evaluate earthquake potential of the WCFZ and associated faults. The results provide a complete chronology of surface-rupturing earthquakes for western Cache Valley and the northern part of the populous Wasatch Front, and that information will permit accurate estimates of seismic hazard and risk.
- Seismic hazard mapping of Cache Valley using geographic information system (GIS) technology. The results help establish a customized protocol for mapping seismic hazards in the unique geologic environments of north-central Utah and provide seismic-hazard maps in a rapidly developing area near the northern Wasatch Front.
- A seismic hazard study of the Hurricane fault in southwestern Utah, which extends 250 kilometers from Cedar City, Utah, to Peach Springs, Arizona. The results of the investigation will be used to characterize the frequency of surface rupture and segmented behavior of the Hurricane fault, and will greatly improve understanding of seismic hazards in the region at a time when this information can be incorporated into design standards and building practices for on-going development.
- Development of a Quaternary fault database for Utah. Results of the study will provide a convenient reference for earthquake sources in Utah and add to the database for future National Seismic-Hazard Map updates.

- Geotechnical site-response mapping of the Salt Lake Valley, an area of high seismic risk characterized by deep, soft soils in the valley interior and shallow, stiff soils along the valley margins. This combination of geologic features tends to amplify earthquake ground motions relative to rock sites. The resulting maps produced by this effort are useful to earth-science consultants, geotechnical and structural engineers, local government officials, and researchers in the design of structures that do not require detailed site investigations, such as residential and small commercial and industrial buildings, where Uniform Building Code site coefficients are now commonly estimated or ignored. The maps are also being used to develop more accurate probabilistic ground-shaking estimates, regional ground-shaking models for loss-estimation studies, and earthquake scenarios for emergency response planning. The addition of this information to existing state GIS databases for fault zones and liquefaction-hazard zones will allow new data to be readily incorporated, and facilitate effective communication of earthquake hazards to Utah residents.
- A seismic hazard scenario for a magnitude 7 earthquake in Salt Lake City. An earthquake in Utah's metropolitan center would impact the lives of more than 1.3 million people, an area which includes all or part of eight Utah counties. Using ground-shaking maps of this area produced by an ongoing NEHRP-supported study by URS Corporation, UGS, UUSS, and Pacific Engineering & Analysis, the UGS will produce maps at a scale of 1:250,000 using GIS. The maps will be accessible to consulting engineers and geologists, planners, and state and local government agencies to ultimately serve as the scenario earthquake and be the focus for bringing together lifeline managers, engineers, contingency planners, and others to identify specific effects of the earthquake for emergency-response planning.
- Microzonation maps for earthquake ground shaking in the Salt Lake City metropolitan area. The UGS will publish a series of nine deterministic earthquake scenario and probabilistic ground shaking maps prepared by URS Corporation, UGS, UUSS, and Pacific Engineering and Analysis that ultimately will be used by the public, the engineering community, government agencies, and all interested parties involved in earthquake mitigation in Utah.
- Trenching efforts of the Wasatch fault zone. The UGS is assisting in a project to add detailed information of ancient earthquakes obtained by excavating large trenches on the Wasatch fault.
- Strong-motion recorders. Researchers from the USGS, UUSS, and UGS have installed and/or upgraded strong-motion accelerographs in the Salt Lake Valley that will record the next sizable earthquake in the valley. The goal of the study is to define how seismic shaking will affect the urban area during a major earthquake.

#### **OUTCOME**

The maps will add substantially to the information available to planners and public officials, who can use the maps to reduce the impact of seismic hazards on future development and manage post-earthquake response and recovery efforts. The trenching efforts will potentially aid scientists in earthquake forecasting worldwide and provide more accurate information on which to estimate damage in communities along the Wasatch Front. Data from the strongmotion sites will provide more statistically reliable data about the various soil types in the valley, and records from the array will be used by engineers and seismologists for investigations into structural responses, analyses of basin effects, ground-motion attenuation, and comparison of ground acceleration data with intensities.

# RECOGNIZING EARTHQUAKE HAZARDS, ASSESSING RISKS FOR COMMUNITIES, AND PREPARING COMMUNITIES FOR EMERGENCY RESPONSE

## **STRATEGIES ADDRESSED**

- 1.1 Inform citizens about earthquake hazards and risks.
- 2.1 Establish Community Emergency Response Teams (CERT) statewide.
- 2.4 Enhance the integrated emergency management system statewide.
- 5.1 Update estimates of direct losses to be expected from earthquakes.
- 5.2 Evaluate the indirect losses associated with earthquakes.
- 5.4 Conduct lifeline collocation vulnerability studies.

#### **ACTION**

The Utah Division of Comprehensive Emergency Management (CEM), with the active support of the Commission's Awareness and Education Standing Committee, (AESC), has been involved it two important activities: (1) implementing Hazards United States (HAZUS), a geographic information system-based software program that projects casualties, damage, and lifeline disruption, and (2) providing Community Emergency Response Team (CERT) training. Both initiatives are central to the concept of ensuring that all segments of the state's population will be able to face the emergencies inherent in the aftermath of an earthquake.

HAZUS is a software program that identifies a community's vulnerabilities; CERT training gives its initiates the experience and expertise necessary to respond to community needs.

In 1997, CEM began implementing HAZUS, a Geographic Information System (GIS) program that recognizes earthquake hazards and assesses risks for communities. With its roots in an Applied Technology Council (ATC) pilot project funded by the Federal Emergency Management Agency (FEMA), HAZUS uses a GIS-based software program to map and display demographic information about individual communities, given the size and location of a hypothetical earthquake. HAZUS can estimate the amount of ground shaking, the number of casualties and buildings damaged, the impact on transportation systems, the extent of disruption to utilities, the number of people displaced from their homes, and the estimated cost of repairing projected damage and other effects.

HAZUS projections can be used before an earthquake to:

- develop earthquake-hazards mitigation strategies as countermeasures to potential losses and disruption,
- develop preparedness or contingency plans, and
- anticipate the nature and scope of response and recovery efforts.

After an event, HAZUS information can be used to:

- project immediate economic impact for state and federal resource allocation and support,
- activate immediate emergency recovery efforts, and

• formulate long-term reconstruction plans.

CEM is now in the process of gathering more information about Utah, to include site-specific details about geology, building inventory, utilities, transportation systems, and engineering and geotechnical data. Such information will allow CEM to increase the accuracy of the HAZUS estimates and the ability to customize those estimates to the specific conditions of individual communities. To that end, CEM is working with the University of Utah Seismograph Stations (UUSS) and the Utah State Automated Geographic Reference Center (AGRC) to collect site-specific data. An oversight committee, consisting of representatives from AGRC, CEM, and UUSS will provide direction and coordination with all participating agencies. Funding for the effort will come from FEMA and the CEM Earthquake Program.

In addition, CEM staff in 1999 created a HAZUS Data Users Group (HDUG) to help build up and facilitate the use of the database. HDUG receives training in the use of HAZUS, develops a clearinghouse and associated security for the database, takes on the responsibility of updating information with the HAZUS model, and uses HAZUS analysis to encourage actions aimed at reducing future earthquake damage. At its first meeting, the HDUG saw a demonstration of HAZUS, learned where the databases are stored and how to contribute to them, and received encouragement to enlist support of other potential users and organizations. In the future, the HDUG plans to:

- provide basic and advanced HAZUS training;
- execute a Memorandum of Understanding with AGRC, which has agreed to act as the clearinghouse for the data, provide users with password access so they can contribute and retrieve information, and create a firewall to protect proprietary information;
- update default data, to include allocating funds for staffing and other expenses; and
- motivate agencies and organizations to reduce future earthquake damage.

#### Potential HAZUS users include representatives from:

- city and county agencies such as building inspectors, emergency management teams, planning offices, public works, utilities, and water and sewer districts;
- state agencies such as Public Safety, State Lands, UGS, Automated Geographic Reference Center, Transportation, and USSC;
- federal agencies such as the USGS, Army Corps of Engineers, and Bureau of Reclamation:
- local colleges and universities;
- the private sector such as utilities, cable television providers, oil and gas refineries and pipeline companies, and other large employers; and
- other organizations, both secular and religious.

CEM, in January 2000, conducted HAZUS training for 20 state and local government participants. The training was the first in the country on HAZUS 99, the latest version from FEMA. The training was conducted by Ken Taylor, Earthquake Program Manager from North Carolina.

HAZUS has the potential to raise awareness and serve as a catalyst for change. It can identify hazards and vulnerabilities so communities can focus on solutions. HAZUS helps organizations explore options to prepare for and reduce the effects of earthquakes, and it can be used to compare benefits to costs on projects to ensure that dollars are spent wisely. Eventually, HAZUS can add modules that can reflect other hazards, such as wind, flood, wildfire, and landslides.

The second of CEM's major initiatives has been CERT training, which is necessary to provide citizens with the basic skills to handle their own needs and to respond to the needs of their communities in the event of a disaster. CEM sponsors the program, trains the trainers, and encourages local jurisdictions and organizations to incorporate CERT training in their own disaster preparedness activities.

The course consists of 21 hours of training in:

- preparedness, to include introduction to disasters, impact of disasters on infrastructure, hazards posed by buildings and nonstructural items, and the role of CERTs in disaster response;
- fire suppression, to include identifying and reducing potential fire hazards, basic fire suppression strategies, firefighting resources, and firefighting techniques;
- medical training, to include treatment strategies for life-threatening conditions and principles of triage, head-to-toe assessments, treatment for head wounds, fractures, sprains, burns, and other injuries;
- light search-and-rescue, to include priorities and resources, techniques for assessment and searching, removing victims, and rescuer safety; and
- psychology and team organization, to include post-disaster emotional environments, the Incident Command System, CERT strategies, tactics, and documentation.

The class ends with a course review and a disaster simulation exercise. CEM oversees the program and ensures that the guidelines for instruction and training are followed.

#### **OUTCOME**

HAZUS has the potential of reducing Utah's vulnerabilities to natural hazards, while CERT training brings together private and public sector elements and ensures that they work together with city, county, and corporate emergency planners. CEM promotes effective communication among, and enhances the relationships of, emergency management systems statewide.

# REAL-TIME EARTHQUAKE INFORMATION SYSTEM AND STRONG-MOTION RECORDING

#### STRATEGIES ADDRESSED

- 2.4 Enhance the integrated emergency management system statewide.
- 3.12 Improve lifeline survivability in the event of an earthquake.
- 4.8 Develop incrementally a strong-motion program.
- 4.9 Develop a statewide, real-time earthquake monitoring system.

#### **ACTION**

Initiatives aimed at strong-motion instrumentation and developing capabilities for real-time earthquake information have long involved scientists, engineers, and emergency managers from Utah's state earthquake program.

Important state needs in this regard were defined in 1989 when a legislative study of "Earthquake Instrumentation Needs of Utah" was assigned to the Legislature's Interim Appropriations Committee and the Office of the Legislative Fiscal Analyst—leading to the creation of a blueribbon panel co-chaired by then Senator Craig A. Peterson. Unfortunately, the recommendations of the panel went largely unheeded, save for some small one-time state funding to the Utah Geological Survey in 1992 that enabled seven strong-motion instruments to be installed at scattered sites along Utah's main earthquake belt.

The efforts of many—including advocacy by the Commission during 1998 and 1999—finally bore fruit in 1999 with the announcement that the University of Utah Seismograph Stations (UUSS) would receive federal funding during the federal fiscal year 2000, under a cooperative project with the U.S. Geological Survey, to begin building a real-time urban strong-motion network in the Ogden-Salt Lake City-Provo urban corridor. Thanks to this funding, the University of Utah's earthquake-recording network is being modernized into a multipurpose, real-time earthquake information system. The primary aim is to improve earthquake safety in Utah's dramatically growing Wasatch Front area by providing faster and better information—especially for emergency response and earthquake engineering. A secondary aim is to have basic real-time capabilities in place before the 2002 Winter Olympics.

With the funding from the U.S. Geological Survey, UUSS is installing new sensors, digital processors, computer networks, and communications for this modernized system, which by late 2001 will provide: (1) automated broadcasts of the location and size of a potentially disruptive earthquake, within a few minutes of its occurrence, and (2) automated computer maps (called ShakeMaps), available on the World Wide Web within several minutes of any significant earthquake, showing the geographic distribution and severity of ground shaking. (A ShakeMap is analogous to a Doppler-radar image, giving a useful overview of the location and severity of a potentially threatening disturbance.)

By September 2000, twenty modern digital strong-motion instruments were added to the UUSS seismic network in the Ogden-Salt Lake City-Provo urban corridor. Added funding is being provided in 2001 to expand this urban network to more than 40 stations, enlarging the geographic coverage. This new urban strong-motion network in Utah is being built with seed-funding for an Advanced National Seismic System (ANSS), a large-scale initiative now pending before Congress. If the ANSS receives full funding, Utah's urban network would eventually expand to about 500 stations along the Wasatch Front.

Unlike conventional sensors in the University of Utah's seismic network, strong-motion accelerometers capture high-quality recordings of ground shaking and are designed to stay on scale during moderate to large earthquakes of magnitude 5 or greater. Recordings of strong ground shaking in structures and on the ground near the source of moderate to large earthquakes are fundamentally important in earthquake engineering for setting guidelines in building codes and for safe, cost-effective design and construction practices.

Strong-motion monitoring is integral to a real-time earthquake information system, particularly for providing rapid information to crisis managers—such as public safety officials and operators of utilities, hospitals, dams, and other critical facilities and lifelines—who must make informed decisions for response and recovery when an earthquake happens. Rapid estimates of damage, losses, and impacts on population based on real-time ground-shaking information have become important in meeting requirements for a formal Presidential Declaration of disaster. The information also expedites federal recovery assistance to individuals and communities.

Key elements in successfully completing and sustaining a real-time earthquake information system in Utah will be: (1) capital funding for a major part of the system from federal sources; (2) state funding for a minor part (e.g., to extend coverage to seismically dangerous parts of Utah such as Cache Valley, Brigham City, Richfield, and the St. George-Cedar City area), together with a firm commitment to providing at least part of the system's long-term operational support; and (3) private-sector involvement, particularly in extending the geographic distribution of sensors and perhaps in sharing resources for digital communications.

## **OUTCOME**

With federal funding through the U.S. Geological Survey, and as part of building an Advanced National Seismic System, the University of Utah's earthquake-recording network is being modernized into a multi-purpose, real-time earthquake information system—with special focus on Utah's dramatically growing Wasatch Front urban corridor. Benefits to Utah will include real-time information for emergency management, critical information for earthquake engineering and improved building codes, and new and valuable information for scientific understanding of earthquakes in Utah.

A basic real-time earthquake information system will be in place in the Wasatch Front area before the 2002 Winter Olympics, when international attention will demand rapid information, in the unforeseen event of any disruptive local earthquake activity.

#### A UNIFIED UTAH EARTHQUAKE MASTER MODEL

#### STRATEGY ADDRESSED

4.10 — Monitor faults using GPS measurements.

#### **ACTION**

At the October 10, 1997, quarterly meeting of the Commission, Robert D. Smith, Ph.D., Professor of Geophysics at the University of Utah, presented a proposal for a "Unified Utah Earthquake Master Model," intended to be a vehicle for integrating various types of earth-science information for earthquake research and practical applications. He described new measurements from Global Positioning System (GPS) monitoring which indicated higher-than-expected rates of extensional strain across an area encompassing the Wasatch fault. These results could be factored into, and would increase, probabilistic estimates of the ground shaking hazard in the Wasatch Front area.

The Commission referred his proposal to the Geoscience Standing Committee (GSC) to answer four questions: (1) Do the high GPS rates indicate that the earthquake hazard in the Wasatch Front region is higher than previously estimated? (2) Do the high GPS rates warrant immediate action by the Commission? (3) Is this unified master model proposal technically applicable in Utah? and (4) How should the Commission proceed?

At the January 9, 1998, quarterly meeting, the GSC reported to the Commission that the higher GPS rates do not necessarily indicate an increased earthquake hazard because of uncertainties in the measurements themselves as well as in the interpretation of the cause of the higher rates of movement. The GSC recommended that more continuous-monitoring GPS instruments be installed, that further scientific work be done on extensional strain measurement and interpretation, and that a scientific workshop be held under the auspices of the Commission to develop a strategic plan to consider the master model proposal and other geoscience initiatives.

Dr. Smith has continued his GPS research with funding from the U.S. Geological Survey (USGS), concentrating on three elements: (1) installation and maintenance of four continuous recording GPS sites on the Wasatch Front; (2) incorporation of data from six Harvard Smithsonian-Caltech Basin-and-Range continuous GPS stations in the eastern Basin and Range, for a total of 10 stations; and (3) research on understanding time-varying behavior of the Wasatch normal fault incorporating GPS-derived motions, the paleoseismic record, and fault stress interactions.

#### **OUTCOME**

Smith's efforts have resulted in the establishment of a 4-station continuous GPS network on the Wasatch Front. With the installation of six Harvard/Cal Tech stations in western and central Utah, at least ten continuous GPS stations transmit data on a daily basis. Furthering a master model approach to analyzing earthquake behavior in Utah awaits consensus-building among scientific researchers regarding the viability of such an approach.

# NATIONAL SCIENCE FOUNDATION REQUEST FOR PROPOSALS TO FUND EARTHQUAKE-ENGINEERING RESEARCH CENTERS

#### **OBJECTIVES ADDRESSED**

- 3 Improve the seismic safety of buildings and infrastructure
- 4 Improve essential geoscience information

#### **ACTION**

In 1996 the National Science Foundation (NSF) issued a request for proposals to fund earthquake-engineering research centers. The Commission unanimously voted to support a proposal from a consortium including Brigham Young University (BYU), Utah State University, the University of Utah, Portland State University, the Oregon Department of Geology and Mineral Industries, and the Utah Geological Survey.

The principal author of the proposal, Matthew Mabey, Ph.D., of the Geology Department at BYU, said the proposed Utah center would have a geotechnical-engineering, rather than a structural-engineering, emphasis. The center would initially have two goals: (1) engage in research to develop and implement methods for supplying geotechnical-engineering design parameters for the cost-effective reduction of losses, and (2) advance the ability to quickly identify the most vulnerable structures, leading to more cost-effective expenditures to increase the benefit-to-cost ratio for mitigation. The completed proposal was submitted to the NSF in October 1996.

#### **OUTCOME**

In April 1997, the National Science Foundation announced it was re-evaluating the program and postponed funding decisions. Funding was ultimately awarded to three other proposed centers in California, New York, and Illinois.

#### THE RELEVANCE OF SEISMIC SAFETY COMMISSIONS

## STRATEGIES ADDRESSED

- 1.1 Inform citizens about earthquake hazards and risks.
- 3.1 Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.
- 3.14 Reduce structural hazards in older private buildings by retrofitting to current seismic building requirements.

#### **ACTION**

The Commission opened its 2nd Quarterly Meeting of 1999 to outside advice, inviting Ron Lynn, the chair of Nevada Earthquake Safety Council, to relate how the Nevada group maintains its relevance.

The Nevada Earthquake Safety Council is an independent organization that "hustles for its money," Lynn noted, adding that seismic safety issues have to be made "real."

"In Utah," he said, "you are trying to educate the public about a low-occurrence/high-impact event. You need to bring your message down to real issues: building and retrofitting to mitigate earthquake damage is smart and increases property values; educating school children about the potential for earthquakes and ways to survive them is good for the future; enforcing building codes that require setbacks from fault lines is good business. Trust your constituents, and remember: all building codes—in a very real sense—are written in blood."

Lynn, who is the Assistant Director of the Clark County, Nevada, Building Department, spoke during a luncheon forum to address building code issues. The hottest topic was the Gateway Project, which will involve extensive remodeling of older buildings on Salt Lake City's near-west side. Lynn's presentation, "A Rational Approach to Building Codes: Practical Issues and Local Challenges Relating to Seismic Codes, Retrofit, and Fault-Setback Ordinances," sparked lively discussions among the structural engineers and architects present. Lynn stressed that this kind of communication needs to continue until a consensus is reached, and that contractors and building officials must be involved.

#### **OUTCOME**

The Commission resolved (1) to go into the 2000 State Legislative Session with proposed changes to its charter that would include language allowing it to solicit funds rather than rely only on a small annual legislative appropriation, and (2) to actively persuade Utah's Uniform Building Code Commission to adopt updated seismic codes for new construction and remodeling projects.

#### **DISASTER-RESISTANT COMMUNITIES**

#### STRATEGIES ADDRESSED

- 1.1 Inform citizens about earthquake hazards and risks.
- 1.3 Disclose geologic hazards in real estate transactions.
- 3.3 Improve the post-earthquake operational status of essential service buildings.
- 5.1 Update estimates of direct losses to be expected from earthquakes [and mitigation strategies].
- 5.2 Evaluate the indirect losses associated with earthquakes [and mitigation strategies].

#### **ACTION**

The challenge of improving earthquake safety in Utah inevitably faces changing circumstances and demands—which calls for versatility, both in focus and tactics. One prominent circumstance that has captured the Commission's attention is the growth dynamic in the greater Wasatch Front Area. Population in this area is well known to be growing dramatically from its 1995 base of 1.6 million and is projected to reach 2.7 million by 2020 and 5 million by 2050. This increases the urgency of taking actions that will make Utah's communities more disaster-resistant.

The Commission invited Natalie Gochnour, an economist in the Governor's Office of Planning and Budget, to its January 1998 meeting to present information gathered by the program *Envision Utah*, formerly known as the Utah Quality Growth Public/Private Partnership, sponsored by the Coalition for Utah's Future. Ms. Gochnour presented findings on population, transportation, air quality, water, and land use, all of which provided a useful perspective for the Commission in identifying future needs and priorities for earthquake-related mitigation actions. An inescapable fact is that Utah's future growth and development in the Wasatch Front area will take place right on top of the active Wasatch fault.

In terms of changing tactics, at the Commission's July 1999 quarterly meeting, the Awareness and Education Standing Committee (AESC) reported that they were working on two initiatives:

- making data on geologic hazards more accessible to policy- and decision-makers in Utah,
   and
- exploring ways to use lobbyists from private companies to advance the Commission's agenda in the State Legislature.

One of the premier issues identified by this committee was the creation of legislation that would mandate complete disclosure of geologic hazards to potential buyers of real estate. Utah does not now have such a requirement, and the committee will work with representatives and lobbyists from the real estate, construction, and insurance industries to make full disclosure a reality.

A tangible benefit of the close cooperation between federal, state, and local emergency managers in mitigating the effects of disaster was the awarding of FEMA funding to several Utah

communities for *Project Impact: Building a Disaster-Resistant Community*. Communities awarded grants by FEMA include: Centerville, 1998; Salt Lake City, 1999; Logan and Moab, 2000; and Provo, 2001. The grants, ranging from \$150,000 to 500,000 will be used to develop long-term cooperative initiatives by continuously engaging and leveraging the resources of the city with the resources of its private sector *Project Impact* partners.

Project Impact is a nationwide effort aimed at protecting families, businesses, and communities by reducing the effects of disasters. FEMA, in awarding the grants, recognizes the strong infrastructure of these communities and the willingness of representatives from the public and private sectors to work together to mitigate hazards, both natural and human-caused. Project Impact will be managed by communities' emergency management offices in cooperation with CEM and FEMA.

#### **OUTCOME**

The Commission is firmly committed to take actions that will help make Utah's communities more disaster resistant—particularly in view of the dramatic growth and development in the greater Wasatch Front Area. Funding from FEMA to selected communities in Utah under Project Impact will directly aid in creating disaster-resistant communities.

#### COMMISSION MEETINGS OUTSIDE THE SALT LAKE CITY AREA

#### STRATEGIES ADDRESSED

- 1.1 Inform citizens about earthquake hazards and risks.
- 5.1 Update estimates of direct losses to be expected from earthquakes.

#### **ACTION**

The Commission traveled to Brigham City for its second quarterly meeting of 1998 to meet with the public as well as local and state officials from Box Elder, Cache, and Weber counties. The Commission's second quarterly meeting of 2000 was held in Provo at Brigham Young University (BYU) with representative from the communities in Utah County. Meeting in public and away from Salt Lake City provides an excellent opportunity for the Commission to spread its message of taking responsible action to promote earthquake safety in communities along the Wasatch Front. The Commission's second meeting of 2001 will be held in Ogden.

After some standard introductory presentations by various commissioners, the Brigham City meeting became an open discussion between the Commission and local officials, who asked what defensive actions could be taken to advance earthquake safety in northern Utah and how the Commission could help them achieve results. There was additional discussion about the political and economic problems the region faced in implementing prudent, defensive actions and what was needed that the Commission might be able to provide or facilitate. Local officials emphasized the need for timely information and updated maps of earthquakes and associated hazards. The officials believed they were doing a good job of planning for emergency response, especially in the first hours and days after an event — but there was less satisfaction with the capability for reducing exposure in advance of the event. Citizen awareness of and support for seismic safety issues were coming from schools and Parent-Teacher Associations, while resistance was noted in public sectors having to do with land-use planning. There followed a discussion on problems associated with enforcement of restrictions on building in unsuitable areas and whether building codes were adequate. Local officials believed they were doing a good job of plan review checks and quality control on contractors.

At the meeting in Provo at BYU, several speakers—at the invitation of the Commission—presented their views on issues related to earthquake hazards, safety, and emergency response and preparedness. Kerry Baum, Emergency Preparedness Coordinator for BYU, described efforts by the university to implement earthquake-safety measures on campus. These efforts include extensive employee training, food stockpiling, purchase of water-purification equipment, and non-structural reinforcement to reduce hazards. Les Youd, Chairman of the Civil and Environmental Engineering Department at BYU, discussed earthquake hazards within Utah County and related engineering techniques. Tricia Porter, Emergency Management Coordinator for Provo City, reported on the Provo Emergency Operations Center and implementation of its functions during future earthquakes. Chuck Hugo, Chief Building Official for Provo City, spoke about

construction techniques within the city and the relationship of infrastructure to earthquake hazards. Jerry Grover, Chair of the Utah County Commission, described county efforts to address earthquake hazards in comprehensive planning documents.

#### **OUTCOME**

Holding Commission quarterly meetings outside of the metropolitan area of Salt Lake County has become a valuable out-reach tactic. More meetings in other regions of the state are planned, and local officials and the general public welcome the visits and the open exchange of ideas and concerns.

#### PRIORITIES FOR THE FUTURE

The scope of what has to be done to improve earthquake safety in Utah demands simultaneous attention to the many facets of being prepared to (a) withstand, (b) respond to, and (c) recover from earthquakes. The diverse makeup of the Commission and its standing committees enables such attention. The Commission has identified nine important action items on which to focus next. All are relevant to three primary objectives in the Commission's 1995 strategic plan: (1) increase earthquake awareness and education; (2) improve the seismic safety of buildings and infrastructure; (3) improve—and effectively use—essential geoscience information.

In unranked order, the Commission's priorities for the immediate future are the following:

- Expand the Commission's "Prepared Schools" program to increase earthquake safety and disaster-preparedness in Utah's K-12 schools (see p. 3 and p. 5) and in institutions of higher learning.
- Advocate requirements for seismic improvements in older commercial and highoccupancy buildings during major remodeling or when certain other changes are made in order to increase life-safety during moderate to large earthquakes (see p. 17).
- Improve the survivability and post-earthquake usability of essential service buildings (see, for example, p. 19).
- Evaluate the seismic vulnerability of Utah's lifelines so that long-range seismic retrofit strategies can be developed (see p. 26 regarding transportation lifelines).
- Ensure that geologic-hazards investigations are performed for the safe siting of all new schools and critical public facilities.
- Continue assisting local governments with geoscience information and with guidance in planning and land-use in order to reduce risks from earthquakes and other geologic hazards (see p. 27).
- Support ongoing efforts by the University of Utah Seismograph Stations and the U.S. Geological Survey in developing urban strong-motion monitoring and a real-time earthquake information system in the greater Wasatch Front Area as part of an Advanced National Seismic System (see p. 37).
- Ensure that design professionals and building officials are kept current on relevant geoscience information.
- Advocate the disclosure of known geologic hazards in real-estate transactions so that homebuyers, prior to purchase, are appropriately informed of the risk they are assuming.

#### OTHER STRATEGIC OBJECTIVES

Since 1995 when the Commission created *A Strategic Plan for Earthquake Safety in Utah*, 27 (or three-fourths) of its 35 strategic objectives have either been successfully met or are being addressed in an ongoing way. Others not yet mentioned in this report and remaining to be addressed are the following:

2.2 — Develop effective exercise and training programs for hospitals
2.3 — Enhance communication capabilities for emergency responders
3.5 — Mitigate nonstructural hazards in government-owned buildings
3.7 — Improve safety and operational ability of older hospital buildings
3.9 — Improve the seismic safety of older homes
3.10 — Improve safety of mobile homes
3.11 — Prevent loss of historic buildings

Strategies 2.2 and 3.7 (hospitals) need the active participation and commitment of all the state's hospitals, for-profit and not-for-profit alike. Thankfully, some major health-care providers are already taking proactive measures. Hospitals occupy a unique position in any seismic mitigation scheme because they must remain operational in order to deal with casualties; no one else can fill that role. If hospitals cannot survive, casualties will be compounded.

With the implementation of *Project Impact* in Salt Lake City, and also with preparations for the 2002 Winter Olympics, communication capabilities for emergency responders (2.3) are being progressively enhanced—at least in the Salt Lake Valley. Communication capabilities for emergency response in other parts of Utah still need to be improved, and the Commission will use its influence to motivate needed actions.

The remaining strategies (3.5, 3.9, 3.10, and 3.11) will require more aggressive awareness and education, the commitment and involvement of communities and zoning agencies, and relevant legislation. Again, the Commission will use its influence to advocate needed improvement in these areas.

Mitigating the effects of earthquakes is a complex task. The effort begins with awareness, but has to be sustained with education, training, technical investigations, and a long-term commitment to risk reduction and preparedness. The Commission exists to help meet these challenges and will continue to do so.

# APPENDIX A

# THE STANDING COMMITTEES OF THE USSC, DECEMBER 2000

# Awareness and Education Standing Committee (incorporating an earlier separate committee on Emergency Management)

Robert D. Carey Deborah H. Kim Tricia Porter Committee Chair University of Utah Medical Center Provo City

Utah Division of Comprehensive

Emergency Management Brian Law Bruce A. Spiegel
Davis County Emergency Services Utah Division of Risk

Jan Gibbons Management

Davis School District Pat Lewis

State Farm Insurance Company Michael W. Stever

Andrew Glad SLC Dept. of Mgmt Services

Sandy City Fire Department Ed O'Sullivan
Ouake Pro Valdee Wiltsey

Utah Office of Education

# Former Committee Members During July 1996-June 2000 (including former members of Emergency Management Standing Committee)

Ann M. Becker, 1997-2000 Gary Madsen, 1996-2000

URS Corporation Department of Sociology, Utah State University

M. Lee Allison, 1996-1999

Utah Geological Survey

Karen Mayne, 1996-1999

Provo City Police Department

Cathy Bledsoe, 1996-1999 *Utah State PTA Emergency Preparedness*Robert Nielson, 1998-1999 *Mountain Fuel Supply Company* 

Committee

Deedee O'Brien, 1996-1999 Jennifer Brown, 1999-2000 *Utah Geological Survey Board* 

State Farm Insurance Company

Kathy Ochsenbein,1998-1999

Bob Halloran,1998-1999

Roy Junior High School

Salt Lake County Fire, Emergency Services

Bureau Patrick Reese, 1998-1999

Church of Jesus Christ of Latter-Day Saints

Pat Iannone, 1996-2000

Utah Association of Realtors

Alan D. Rindlisbacher, 1998-1999

Layton Construction Company

Layton Construction Company Judy Johnson, 1998-1999

State Farm Insurance Companies Paul Wanlass, 1996-2000
Salt Lake Courty Water Conservancy Di

#### **Engineering and Architecture Standing Committee**

Barry H. Welliver Carl Eriksson

Committee Chair West Jordan Development Services

Structural Engineers Association of Utah

Max A. Gregersen Roger Evans
Salt Lake City Corp.

CEntry Contractors & Engineers, Inc.

Thair Blackburn

Matthias Mueller

Utah Div. of Facilities Const. and Mgmt.

Blackburn Architects

Barry Smith

Parry Brown Hart, Fisher, Smith & Associates

Reaveley Engineers & Associates, Inc.

Dunn Associates, Inc.

Utah Geological Survey

Ron Dunn

# Former Committee Members During July 1996-June 2000

James S. Bailey, 1996-2000 Earle Eppich, 1996-1998 William Juszcak, 1996-1998

Allen & Bailey Engineers Reaveley Engineers & Utah Division of Facilities

Associates, Inc. Construction Management

#### **Geoscience Standing Committee**

Gary E. Christenson Matthew Mabey

Committee Chair Brigham Young University

William R. Lund

Walter J. Arabasz
Utah Geological Survey
University of Utah Seismograph Stations

James C. Pechmann

Jon E. Bischoff
University of Utah Seismograph Stations
Utah Department of Transportation

Ronald L. Bruhn

Joergen Pilz

AMEC Earth and Environmental

University of Utah

Kyle M. Rollins
Marvin W. Halling
Utah State University

Kyle M. Rollins
Brigham Young University

James Wells

Jeffrey R. Keaton *Utah Division of Water Rights, Dam Safety* 

AMEC Earth & Environmental

T. Leslie Youd

Brigham Young University

# **Intergovernmental Relations Standing Committee** (assignment of Committee Chair pending)

Jay Aguilar Jerry Grover

Bear River Association of Government Mountainland Association of Governments

Walter J. Arabasz Prescott Muir

University of Utah Seismograph Stations Prescott Muir Architects

Mark Bedel David Owens

Governor's Office of Planning & Budget Five County Association of Governments

Kenneth H. Bullock Carol Page

Utah League of Cities And Towns Wasatch Front Regional Council

Robert D. Carey *Utah Div. of Comprehensive Emergency Mgmt.*Suzanne Winters

State Science Advisor

Diane Conrad

Salt Lake Olympic Organizing Committee

#### **Lifelines and Infrastructure Standing Committee**

David Nazare Peter W. McDonough Committee Chair PRIDE Engineering

Utah Department of Transportation

Joergen Pilz
Steven F. Bartlett

AMEC Earth and Environmental

University of Utah

Robert D. Carey Salt Lake County Conservancy District

Utah Div. of Comprehensive Emergency Mgmt.

Carl H. Carpenter

(Ground-Water Consultant)

#### Former Committee Members During July 1996-June 2000

Paul Wanless

James C. Golden, 1996-1999 Utah Dept. of Transportation

#### **Guidelines Advisory Committee on Local Government Needs\***

\*Established in 1999 to advise the Commission's Geoscience Standing Committee and the Utah Geological Survey on local government needs for geoscience information to reduce risks from earthquakes and other geologic hazards.

Gary E. Christenson Ronald Bruhn
Committee Chair University of Utah
Utah Geological Survey

Scott Carter
Carl Eriksson
Committee Advisor

Layton City Development Services

West Jordan Development Services Andrew Jackson

Mountainlands Association of Governments
Craig Barker

Weber County Planning

Jeffrey R. Keaton

AMEC Farth and Environme

AMEC Earth and Environmental
Darlene Batatian

Salt Lake County Planning
William R. Lund
Utah Geological Survey
Jon Bischoff

Utah Department of Transportation Lane Nielson
Wasatch Front Regional Council

## APPENDIX B

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# UTAH SEISMIC SAFETY COMMISSION ACT AMENDMENTS

2000 GENERAL SESSION STATE OF UTAH

**Sponsor: Don E. Bush** 

AN ACT RELATING TO BOARDS AND COMMISSIONS; MODIFYING THE MEMBERSHIP OF THE UTAH SEISMIC SAFETY COMMISSION; ESTABLISHING FUNDING PARAMETERS; AND MAKING TECHNICAL CORRECTIONS.

This act affects sections of Utah Code Annotated 1953 as follows:

#### **AMENDS:**

- **63C-6-101**, as last amended by Chapter 270, Laws of Utah 1999
- 63C-6-102, as enacted by Chapter 136, Laws of Utah 1994
- **63C-6-104**, as enacted by Chapter 136, Laws of Utah 1994

Be it enacted by the Legislature of the state of Utah:

Section 1. Section **63C-6-101** is amended to read:

#### 63C-6-101. Creation of commission -- Membership -- Appointment -- Vacancies.

- (1) There is created the Utah Seismic Safety Commission consisting of [13] 15 members, designated as follows:
  - (a) the commissioner of the Department of Public Safety;
- —] (a) the director of the Division of Comprehensive Emergency Management or his designee;
  - [<del>(e)</del>] <u>(b)</u> the director of the Utah Geological Survey <u>or his designee</u>;
  - [(d)] (c) the director of the University of Utah Seismograph Stations or his designee;
  - [(e)] (d) the executive director of the Utah League of Cities and Towns or his designee;
- [<del>(f)</del>] <u>(e)</u> a representative from the Structural Engineers Association of Utah biannually selected by [the] its membership;
- [<del>(g)</del>] <u>(f)</u> the director of the Division of Facilities and Construction Management or his designee;
  - [(h)] (g) the executive director of the Department of Transportation or his designee;
  - [(i)] (h) the State Planning Coordinator or his designee;
  - [(i)] (i) a representative from the American Institute of Architects, Utah Section;
  - [(k)] (j) a representative from the American Society of Civil Engineers, Utah Section;
- $[\underbrace{(+)}]$  ( $\underline{k}$ ) a member of the House of Representatives appointed biannually by the speaker of the House; [and]
  - [<del>(m)</del>] (1) a member of the Senate appointed biannually by the president of the Senate[-];
  - (m) the commissioner of the Department of Insurance or his designee;

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(n) a representative from the Association of Contingency Planners, Utah Chapter, biannually selected by its membership; and

- (o) a representative from the American Public Works Association, Utah Chapter, biannually selected by its membership.
- (2) The commission shall annually select one of its members to serve as chair of the commission.
- (3) When a vacancy occurs in the membership for any reason, the replacement shall be appointed for the unexpired term.

Section 2. Section **63C-6-102** is amended to read:

# 63C-6-102. Meetings -- Duties -- Committees.

- (1) The commission shall meet at the call of the chair, but not less than once each quarter.
- (2) The commission shall:
- (a) review earthquake-related hazards and risks to the state of Utah and its inhabitants;
- (b) prepare recommendations to identify and mitigate these hazards and risks;
- (c) prioritize recommendations and present them to state and local government or other appropriate entities for adoption as policy or loss reduction strategies;
- (d) act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures;
- (e) prepare a strategic seismic planning document to be presented to the State and Local Interim Committee before the 1995 annual general session of the Legislature; and
- (f) periodically update the planning document and monitor progress toward achieving the goal of loss reduction.
  - (3) The commission may:
- (a) divide into or create subcommittees as it determines necessary to carry out its duties under this section[-]; and
- (b) accept contributions from other private or public sources and seek grants or funding from the federal government for uses relating to seismic safety.

Section 3. Section **63C-6-104** is amended to read:

#### 63C-6-104. Staffing and appropriated funds.

- (1) Staff support to the commission shall be provided by the Division of Comprehensive Emergency Management and the Utah Geological Survey.
- (2) Monies not expended by the Utah Seismic Safety Commission during a fiscal year are nonlapsing except that any balance of General Fund monies greater than \$10,000 lapses to the General Fund.

# **APPENDIX C**

# STRATEGIC PLAN'S OBJECTIVES AND STRATEGIES

## Objective 1: Increase earthquake awareness and education

Strategies	•	1.1	Inform citizens about earthquake hazards and risks.
Strategies		1.1	IIIIOIIII CIUZCIIS ADDUL CALUIUUAKE HAZAIUS AHU HSKS.

- ▶ 1.2 Incorporate earthquake education in school curricula.
- ▶ 1.3 Disclose geologic hazards in real estate transactions.

# **Objective 2: Improve emergency response and recovery**

Strategies	•	2.1	Establish Community Emergency Response Teams (CERTs)
			statewide.

- ▶ 2.2 Develop effective exercise and training programs for hospitals.
- ► 2.3 Enhance communication capabilities for emergency responders.
- ▶ 2.4 Enhance the integrated emergency management system statewide.

# Objective 3: Improve the seismic safety of buildings and infrastructure

Objective 5. Improve the seisinic safety of bundings and infrastructure				
Strategies	•	3.1	Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.	
	•	3.2	Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings.	
	•	3.3	Improve the post-earthquake operational status of essential service buildings.	
	•	3.4	Reduce structural hazards of government-owned buildings.	
	•	3.5	Mitigate nonstructural hazards in government-owned and -leased buildings.	
	•	3.6	Improve safety of older public school buildings.	
	•	3.7	Improve safety and operational ability of older hospital buildings.	
	•	3.8	Improve safety of older high-occupancy buildings (250 persons or more) to be structurally competent enough to withstand moderate to large earthquakes.	
	•	3.9	Improve the seismic safety of older homes	

- ► 3.9 Improve the seismic safety of older homes.
- ▶ 3.10 Improve safety of mobile homes.
- ▶ 3.11 Prevent loss of historic buildings.
- ▶ 3.12 Improve lifelines survivability in the event of an earthquake.
- ▶ 3.13 Improve earthquake performance of water and waste-water systems.

## **Objective 4: Improve essential geoscience information**

# Strategies 4.1 Reduce earthquake losses by mapping and identifying geologic hazards.

- ► 4.2 Perform geologic-hazards investigations for critical public facilities.
- ► 4.3 Make land use compatible, through local government ordinances, with known hazards.
- ► 4.4 Ensure design professionals and building official are kept current on relevant geoscience information.
- ► 4.5 Determine appropriate seismic criteria and procedures for evaluating performance of existing dams.
- 4.6 Reduce earthquake-induced liquefaction risk to highway structures.
- ▶ 4.7 Determine appropriate seismic design coefficients for highway bridges.
- ► 4.8 Develop incrementally a strong-motion program.
- ▶ 4.9 Develop a statewide, real-time earthquake monitoring system.
- ► 4.10 Monitor faults using Global Positioning System (GPS) measurements.

## Objective 5: Assess earthquake risk

# Strategies • 5.1 Update estimates of direct losses expectable from earthquakes.

- 5.2 Evaluate the indirect losses associated with earthquakes.
- ► 5.3 Conduct lifeline collocation vulnerability studies.

# SCHOOL EMERGENCY PREPAREDNESS

# APPENDIX D **Prepared Schools Certification**

## Level I

 Our alarms, which may include fire protection systems and possibly strobe lights, are maintained and in
working order and are in compliance with the local Fire Marshal's inspection. (R277-400-7 B (4) & R277-400-8 A)
 We hold fire drills once a month if we are an elementary school and every other month if we are a secondary
school. (R277-400-7 B) (Uniform Fire Code 1303.3.3.2.1) (Utah Fire Marshal's Rules and Regulations) (R710-4-3.9.2)
 We hold one other type of drill yearly i.e., earthquake drill, violent intruder, etc. (R277-400-7 C)
 We hold an Emergency Preparedness Week prior to April 30 (preferably during the month of April) of each school year. (R277-400-7 E)
 We have a first aid kit in the main office that is currently stocked and portable. (Utah Administrative Code Rule R392 200-7-A-1)
 We have a record of all students on medication and/or receiving special health services. ( <i>Utah Administrative Code</i> 53A-11-601) ( <i>Utah Administrative Code Rule R392-700-7.3 &amp; 4</i> ) ( <i>Guidelines for Children with Special Health Care Needs, p.23</i> )
 We have provisions for back up medication for the special needs of students and staff in our school.
 We have assessed and recorded the abilities of our staff i.e. C.P.R., C.E.R.T., First Aid, etc.
 We have three people currently certified in first aid and C.P.R. (Utah Administrative Code Rule R392-200-7 A) (Utah Administrative Code Rule R392-200-7-A-1)
 We have an active Safety Committee which includes an administrator, teacher, custodian, and a member of the P.T.A. (R277-400-3 B & R277-400-4 A & B)
 We have a policy and procedure for contacting parents and releasing students following a disaster. ( $R277-400-6$ $A \& B$ )
 We have emergency procedures in place for evacuating students with special health care needs i.e., wheelchair
bound, and those who use assisted walking devices. (Guidelines for Children with Special Health Care Needs)
Nonstructural hazards:
 We hold an annual nonstructural hazard hunt in all classrooms.
 We have defined our nonstructural hazards in easy-fix, low-cost, and long-term categories.
 We have taken care of all easy-fix hazards.

Please note: The Utah State Board of Education Policies and Procedures have been listed in the parentheses following each item, unless otherwise noted.

Level	II (includes everything in level I as well as the following):
	We have invited our local police and fire departments to be a part of our safety committee. (R277-400-3 B)
	We have the necessary equipment for special-need students and staff, such as backup power for a ventilator. (Guidelines for Children with Special Health Care Needs)
	We have expanded our fire drills to include obstacles that will add confusion to the evacuation i.e., blocked doors, missing persons, etc.
	We have a backpack (or container) in every classroom with the minimum of supplies suggested by the Schools Subcommittee for the Utah Seismic Safety Commission needed for a disaster. This container is checked and updated annually.
	We have 10% or four persons, whichever is greater, of our full-time staff currently certified in CPR and first aid. Schools with less than 10 people on staff will be given special considerations.
	We have a five-year plan to reduce long-term nonstructural hazards. We have addressed all low-cost nonstructural hazards.
	We have completed a Hazard and Risk Assessment.
	We have an all-hazards emergency response plan. Examples of school plans are available from the Division of Comprehensive Emergency Management. (R277-400-4)
	We inform parents, students, and staff of their part in the plan annually. (R277-400-5)
	We train and educate students and staff on emergency response procedures for the specific hazards compiled in our Hazard and Risk Assessment. (R277-400-6)
	We hold annual drills which include evacuation of all persons in the building, accountability of the entire staff and student body, and release of students in accordance with the school plan. Each drill has been evaluated by our Safety Committee. (R277-400-6 B) (Uniform Fire Code 1303.3.3.2.2)
	We have tested our plan in a tabletop exercise and have made the appropriate modifications to the plan.
	We have submitted our school emergency response plan for review to the <i>Utah Seismic Safety Commission</i> , <i>c/o Bob Carey</i> , 1110 State Office Building, SLC, UT 84114.

What should be included in the School Emergency Response Plan:  Our plan includes procedures to respond to all the hazards compiled in the Hazard and Risk Assessment, including violence.  Our plan includes all policies and procedures listed in Level 1.  Our plan includes procedures for contacting school district personnel, the school nurse, and parents.  Our plan includes what students, teachers, staff, and others in the building should do during and immediately following an earthquake. (Some schools do not have earthquakes, but when students travel to an earthquake prone area they need to know what to do.)  Our plan includes a policy and procedure for sheltering the students for 24 hours.  Our plan has been disseminated to the district office, and the local fire and police departments for their information
Web Page Resources:
Home page for School Subcommittee of the Utah Seismic Safety Council: <a href="http://www.davis.k12.ut.us/emrprep/schsub/schsub.htm">http://www.davis.k12.ut.us/emrprep/schsub/schsub.htm</a>
Contents of backpack or bucket: <a href="http://www.davis.k12.ut.us/emrprep/schsub/backpack.htm">http://www.davis.k12.ut.us/emrprep/schsub/backpack.htm</a>
How to evacuate a building: <a href="http://www.davis.k12.ut.us/emrprep/schsub/bldevac.htm">http://www.davis.k12.ut.us/emrprep/schsub/bldevac.htm</a>
Drill Evaluation: <a href="http://www.davis.k12.ut.us/emrprep/schsub/drilleva.htm">http://www.davis.k12.ut.us/emrprep/schsub/drilleva.htm</a>
Earthquake drills: <a href="http://www.davis.k12.ut.us/emrprep/schsub/eqdrill.htm">http://www.davis.k12.ut.us/emrprep/schsub/eqdrill.htm</a>
Earthquake drill evaluation: <a href="http://www.davis.k12.ut.us/emrprep/schsub/eqdrlevl.htm">http://www.davis.k12.ut.us/emrprep/schsub/eqdrlevl.htm</a>
Evacuation of School Grounds: <a href="http://www.davis.k12.ut.us/emrprep/schsub/evacgrds.htm">http://www.davis.k12.ut.us/emrprep/schsub/evacgrds.htm</a>
Fire Alarm Log:

http://www.davis.k12.ut.us/emrprep/schsub/firelog.htm

Non-structural Hazard Hunt:

http://www.davis.k12.ut.us/emrprep/schsub/hazhunt.htm

Medical Release Form:

http://www.davis.k12.ut.us/emrprep/schsub/medrelse.htm

Missing Persons Form:

http://www.davis.k12.ut.us/emrprep/schsub/misngfrm.htm

Parent Release Form (who can I release the students to?): http://www.davis.k12.ut.us/emrprep/schsub/parelse.htm

How to release students to parents:

http://www.davis.k12.ut.us/emrprep/schsub/re2prnts.htm

Student Release Form (actual sign out form):

http://www.davis.k12.ut.us/emrprep/schsub/srelfrm.htm

Workshop information flyer:

http://www.davis.k12.ut.us/emrprep/schsub/wkspflr.htm

## **APPENDIX E**

# **SURVEY OF SEISMIC SAFETY INITIATIVES, 2000**

The Commission, seeking to add to the insights gained in the 1996 survey of businesses and governments, polled those same audiences to learn more about their state of seismic safety awareness. Two separate questionnaires were sent: one to business organizations (appendix F) and one to cities and counties (appendix G).

The businesses were selected on the basis of their membership in or support of the Association of Contingency Planners. The presumption was that such businesses would be the most likely to have policies and procedures in place to deal with catastrophes and would also be the most likely to share their insights. A total of 52 businesses received the questionnaire; 18, or 35 percent, responded. All the businesses are located within UBC Seismic Zone 3.

Each questionnaire was quantified to a maximum score of 80 points, with total scores categorized into one of four types: Highly Aggressive (61-80 points), Aggressive (41-60), Attentive (21-40), and Minimal (up to 20).

Organizations that participated in the survey included:

Autolive ASP	6,000 employees
Bear River Mutual	52 employees
Bergen Brunswig	70 employees
Brigham Young Univ	3,500 employees
Deseret First C U	110 employees
First Security	2,000 employees
Flying J	1,000 employees
Franklin Quest	2,500 employees
IHC	22,000 employees
Novell	1,500 employees
Questar	1,800 employees
St. Mark's Hospital	1,200 employees
SPS Technologies	200 employees
Thiokol Corporation	3,400 employees
Utah Power	2,800 employees
Utah Valley State	2,000 employees
Workers Compensation	335 employees

Zions Bancorporation 6,000 employees

The other questionnaire went to all 29 counties (12 responses for 41 percent) and all cities in Utah with a population of more than 1,000 (31 of the 112 cities, or 28 percent, responded).

#### Counties that responded included:

Beaver	Zone 2B
Box Elder	Zone 2B/3
Cache	Zone 3
Duchesne	Zone 1/2B
Emery	Zone1/2B
Grand	Zone 1
Salt Lake	Zone 3
San Juan	Zone 1/2B
Sanpete	Zone 2B/3
Utah	Zone 2B/3
Wayne	Zone 1/2B
Weber	Zone 3

#### Cities that responded included:

Beaver	Zone 2B
Blanding	Zone 1
Enoch	Zone 2B
Enterprise	Zone 2B
Gunnison	Zone 3
Heber City	Zone 3
LaVerkin	Zone 2B
Logan	Zone 3
Manti	Zone 3
Midway	Zone 3
Monticello	Zone 2B
Naples	Zone 1
North Ogden	Zone 3
Ogden	Zone 3
Orangeville	Zone 2B
Panguitch	Zone 2B
Park City	Zone 3
Payson	Zone 3
Perry	Zone 3
Plain City	Zone 3
Providence	Zone 3
Provo	Zone 3

Richmond Zone 3 Zone 3 Salt Lake City Smithfield Zone 3 South Ogden Zone 3 Spanish Fork Zone 3 Syracuse Zone 3 Tremonton Zone 3 Vernal Zone 1 Zone 2B Wendover

The organizations fell into the following Initiative Ranking categories (percentages are rounded to the next whole number, so some categories may not total exactly 100 percent): Highly Aggressive (10 of 18, or 55 percent), Aggressive (4 of 18, or 22 percent), Attentive (3 of 18, or 17 percent), Minimal (1 of 18, or 6 percent).

Although three of the state's largest employers rank as Highly Aggressive, 40 percent of the organizations in that category have fewer than 400 employees, indicating that the size of the organization is not a factor in whether it focuses on seismic safety issues.

#### The responses:

- Question 1 (5 points) on policies and procedures in place: All organizations had some form of policies and procedures in place for disasters; 78 percent (14 of 18) addressed the issue of seismic safety specifically in their plans.
- Question 2 (5 points) on whether seismic safety issues were discussed by employee councils or management teams: Four (22 percent) said they had never discussed these issues in any forum; 2 (11 percent) were making efforts to establish some way to bring these issues to the employees on a consistent basis; and 12 (67 percent) had discussed the issues with employees on at least an annual basis.
- Question 3 (10 points) on the organization's own rating (from 1 unaware, to 10 fully informed) of its knowledge of earthquake risk factors: 72 percent (13 of

- 18) rated themselves as more than adequately informed.
- Question 4 (5 points) on whether the organization was aware of training in earthquake safety for its safety and security personnel: 78 percent (14 of 18) were aware of such training; and 56 percent (10 of 18) provided that type of training in-house and on a regular basis.
- Question 5 (10 points) on whether earthquake-response training was provided on a regular basis for safety and security people: 33 percent (6 of 18) sent their personnel to annual training, and 33 percent (6 of 18) provided it in-house; 11 percent (2 of 18) provided some training on occasion, and another 17 percent (3 of 18) made such training available more often than annually.
- Question 6 (10 points) on whether other personnel in the organization knew about special training, who received it, and how often: 56 percent (10 of 18) reported having some process in place to keep every one else in the organization, including upper management, informed on a regular basis as to who the seismic safety experts within the organization were.
- Question 7 (5 points) on whether the organization had ever retrofitted or upgraded any of its physical structures to meet earthquake code: 61 percent (11 of 18) reported that they had made some effort in the past four years to upgrade or retrofit one or more of these. Slightly less than a quarter of the respondents (22 percent, or 4 of 18) said their structures were all new so upgrading or retrofitting was not an issue.
- Question 8 (5 points) on whether there was a perception that some of the buildings needed to be upgraded or retrofitted: 56 percent (10 of 18) said they were aware of some needs; and 33 percent (6 of 18) said there was no need.

- Question 9 (5 points) on whether the organization had given any priority to retrofitting or upgrading needs: 61 percent (11 or 18) said the question did not apply or did not respond; 22 percent gave their needs a high priority; and 17 percent gave them a low priority.
- Question 10 (10 points) on frequency of the review process for policy and procedures: 83 percent (15 of 18) said they reviewed their disaster plans on at least an annual basis; 6 percent (1 of 18) did it on a quarterly basis; and 11 percent (2 of 18) did not have a review process.
- Question 11 (10 points) on involvement of management in the review process: 44 percent (8 of 18) involved upper management; 44 percent (8 of 18) involved to the middle-management level; and 12 percent (2 of 18) had no process.

The counties and cities questionnaire also had a maximum of 80 points, though with different questions.

Only one county (8 percent of the total responding) ranks in the Highly Aggressive category (61-80 points), and it is in Seismic Zone 2B/3. In the Aggressive category are three counties (25 percent); two are in Zone 3 and one in Zone 2B/3. Four counties (33 percent) are in the Attentive category; one in Zone 3, two in Zone 1, and one in Zone 1/2B. The Minimal category contains the final four (33 percent); one is in Zone 1/2B, one in Zone 2B, and one in Zone 2B/3.

Because of the distribution of counties throughout the categories, the survey indicated that the Seismic Zone did not play a significant role in any county's Initiative Ranking.

The responses:

 Question 1 (5 points) on ordinances, codes, or planning: 75 percent (9 of 12) listed the Uniform Building Code (UBC) 1997 version as their guideline; 58 percent (7 of

- 12) listed the UBC and local planning or initiatives; and 25 percent (3 of 12) listed no ordinances, codes, or planning for seismic safety.
- Question 2 (10 points) on whether the county commission discussed seismic safety issues: 8 percent (1 of 12) said it was discussed annually; 17 percent (2 of 12) said it was occasionally discussed; and 75 percent (9 of 12) said it was never discussed.
- Question 3 (5 points) on whether building permits had been modified or denied because of earthquake safety issues in the last four years: 42 percent (5 of 12) said it had happened; and 58 percent (7 of 12) said it had never happened.
- Question 4 (10 points) on building inspector knowledge of earthquake hazard issues: 67 percent (8 of 12) ranked themselves 5 or higher on a 10-point scale (1 = no knowledge); and 33 percent (4 of 12) ranked themselves lower than 5.
- Question 5 (5 points) on their knowledge of seismic safety training available for their building inspectors: 42 percent (5 of 12) knew of or participated in at least two methods of training; 25 percent (3 of 12) knew of a course; and 33 percent (4 of 12) had no knowledge of training available.
- Question 6 (5 points) on the number of public/government buildings retrofitted or upgraded in the past four years: 92 percent (11 of 12) had no knowledge of or said no such work had been done; and 8 percent (1 of 12) said there had been at least one incidence of that occurring.
- Question 7 (5 points) on knowledge of public/government buildings that were in need of retrofit or upgrade to meet seismic standards: 58 percent (7 of 12) had no knowledge of such a need or indicated that no need existed within their counties; and 42 percent (5 of 12) said their were aware of

at least a few buildings that were in need.

- Question 8 (10 points) on what priority ranking on a scale of 1 10 (1 = no priority) they would give the need for retrofit or upgrade: 17 percent (2 of 12) ranked the priority at 5 or higher; and 83 percent (10 of 12) put the priority at lower than 5.
- Question 9 (5 points) on whether they thought building permits issued in the past four years were in compliance with existing codes (on a scale of 1 10, 1 = non-compliance): 75 percent (9 of 12) put themselves at a 5 or higher; and 25 percent (3 of 12) said they didn't know.
- Question 10 (5 points) on instances where work had to be interrupted or was otherwise affected because of seismic safety issues: 8 percent (1 of 12) said it had happened at least once; 25 percent (3 of 12) said they didn't know if it had happened; and 67 percent (8 of 12) said it had never happened.
- Question 11 (10 points) on whether there was a review process for seismic safety policies and procedures: 8 percent (1 of 12) had annual discussions; 25 percent (3 of 12) reviewed the policies at least occasionally; and 67 percent (8 of 12) either had no review process of didn't know of any.
- Question 12 (10 points) on whether anyone in authority participated in the review process: 67 percent (8 of 12) said they either had no process, didn't know of a process, or reviewed the policies at the building inspector level; and 33 percent (4 of 12) said the process involved county officials or elected officials.

Of the cities that responded to the survey, 39 percent (12 of 31) had populations less than 2,500; 19 percent (6 of 31) had populations between 2,500 and 5,000; 16 percent (5 of 31) had populations of between 5,000 and 10,000; 13 percent (4 of 31) had populations of between 10,000 and 25,000; and 13 percent (4 of 31) had population of more than 25,000.

In addition, 65 percent (20 of 31) of the cities responding are in Zone 3; 26 percent (8 of 31) are in Zone 2B; and 9 percent (3 of 31) are in Zone 1. That correlates fairly well with the overall averages, which show that 71 percent (80 of 112) of all the cities in Utah that received the survey are in Zone 3; 24 percent of them (27 of 112) are in Zone 2B; and 4 percent (4 of 112) are in Zone 1.

Of the cities that responded, 26 percent (8 of 31) ranked as Highly Aggressive with Seismic Initiative scores of between 61 and 80. All but one of the cities are within Zone 3, and the other is within Zone 2B. One has a population of between 1,000 and 2,500; three have populations of between 5,000 and 10,000; two have populations of between 10,000 and 25,000; and two had populations of more than 25,000.

In the Aggressive category, with Seismic Initiative scores of between 41 and 60, were 26 percent (8 of 31) of the responding cities. Again, all but one are within Zone 3, and the other is within Zone 1. Two have populations of between 2,500 and 5,000; two, between 5,000 and 10,000; two, between 10,000 and 25,000; and two, more than 25,000.

Fewer cities, 19 percent (6 of 31) made up the Attentive category with Seismic Initiative scores of between 21 and 40. Two are in Zone 1; two in Zone 2B; and two in Zone 3. Four have populations of between 1,000 and 2,500; and two, between 2,500 and 5,000.

The Minimal category had 29 percent (9 of 31) with Seismic Initiative scores of 20 or lower. Five are in Zone 2B and four are in Zone 3. Eight have populations of between 1,000 and 2,500; and one, between 2,500 and 5,000.

The Seismic Initiative scores of the cities seem to be affected by their population. The cities that ranked lowest on the scale were among the smallest, but no city with a population of over 5,000 ranked less than Aggressive. All four of the largest cities scored in the Aggressive or Highly Aggressive category.

The responses (the questionnaire was the same as the one used for the counties):

- Question 1 (5 points): 77 percent (24 of 31) relied on the UBC and/or other building codes (IBC, UCBC); 42 percent (13 of 31) relied on the UBC and some local initiatives; 16 percent (5 of 31) had no ordinances; and 6 percent (2 of 31) had only local initiatives to follow.
- Question 2 (10 points): 58 percent (18 of 31) either didn't know or didn't have any reviews or discussions at the city level on seismic hazards; 26 percent (8 of 31) discussed the issue at least occasionally; 16 percent (5 of 31) discussed the issue on at least an annual basis.
- Question 3 (5 points): 32 percent (10 of 31) had denied some permits in the past four years; 58 percent (18 of 31) did not; 10 percent (3 of 31) didn't know.
- Question 4 (10 points): 45 percent (14 of 31) rated themselves at 5 or higher on a scale of 1 10 (1 = no knowledge); 42 percent (13 of 31) rated themselves at less than 5; 13 percent (4 of 31) didn't know.
- Question 5 (5 points): 32 percent (10 of 31) detailed specific training programs they knew of or had participated in; 36 percent (11 of 31) said they knew of some training programs available; 32 percent (10 of 31) knew of no training available.
- Question 6 (5 points) on the number of public/government buildings retrofitted or upgraded in the past four years: 71 percent (22 of 31) had no knowledge of or said no such work had been done; 29 percent (9 of 31) said there had been at least one incidence of that occurring.
- Question 7 (5 points): 81 percent (25 of 31) said they knew of some public/government buildings that needed seismic upgrades or retrofitting; 19 percent (6 of 31) said they

- either didn't know of any or said there were none.
- Question 8 (10 points): 29 percent (9 of 31) rated the priority for upgrading or retrofitting public/government buildings at 5 or higher on a scale of 1 10 (1 = no priority); 71 percent (22 of 31) put that priority at less than 5.
- Question 9 (5 points): 68 percent (21 of 31) rated their compliance at 5 or higher on a scale of 1 10 (1 = non-compliant); 32 percent (10 of 31) said they either didn't know or were at 0 on the scale.
- Question 10 (5 points): on instances where work had to be interrupted or was otherwise affected because of seismic safety issues: 23 percent (7 of 31) said it had happened at least once; 77 percent (24 of 31) said they didn't know if it had happened or said it had never happened.
- Question 11 (10 points): 19 percent (6 of 31) have periodic review of seismic safety ordinances at the city level; 23 percent (7 of 31) have occasional reviews; 58 percent (18 of 31) have no review process or did not know of any.
- Question 12 (10 points): 52 (16 of 31) percent said they didn't know who was involved in the review process or didn't have a review; 48 percent (15 of 31) were able to detail the people involved in the review process.

#### **APPENDIX F**

# SURVEY QUESTIONNAIRE FOR BUSINESS ORGANIZATIONS

- 1. Please list or briefly describe the policies and procedures in your organization that relate to earthquake safety.
- 2. Since July 1, 1996, how many times were seismic safety policies and procedures formally discussed by your employee council or management team?
- 3. How would you rate your knowledge of earthquake risk factors, such as surface fault rupture, liquefaction, and ground shaking? Rate your knowledge on a scale of 1 (unaware) to 10 (fully knowledgeable).
- 4. What training is available to you or your safety and security people to help update/gain knowledge of earthquake risk factors?
- 5. Have you or any of your safety and security people been trained specifically in how to respond to earthquake emergencies? Please specify what training was received and when anyone last attended that training.
- 6. Who else in your organization, including upper management, knows who has special training or expertise in earthquake response? How is that information disseminated, and how often?
- 7. Has there ever been an effort to upgrade or retrofit your building(s) for earthquake safety? Please specify what was done.
- 8. In your opinion, are there structures your organization currently uses that are in need of seismic upgrades/retrofitting? Please specify what those needs are:
- 9. How would you prioritize each need listed in the previous question on a scale of 1 (no priority now) to 10 (immediate concern).
- 10. How often do you review your earthquake safety policies and procedures? Circle one: Annually Quarterly Other (specify) Don't Know Does Not Apply
- 11. Who is involved in the review process? (*Please specify by title; if there is no review process, please indicate*)
- 12. How many employees does your organization have in Utah?

#### **APPENDIX G**

# SURVEY QUESTIONNAIRE FOR CITIES AND COUNTIES

- 1. Please list or briefly describe ordinances, development codes, and planning in your city/county that relate to earthquake safety.
- 2. Since July 1, 1996, how many times were questions of earthquake safety formally discussed by the city council/county commission? Please describe.
- 3. Since July 1, 1996, were there occasions when seismic risk was a consideration in denying or modifying building/development/construction permits? Please briefly describe.
- 4. How would you rate the building inspectors in your jurisdiction as to their knowledge of earthquake risk factors, such as surface fault rupture, liquefaction, and ground shaking? Rate on a scale of 1 (unaware) to 10 (fully knowledgeable).
- 5. What training is available to your building inspectors to help them update/gain knowledge of earthquake risk factors?
- 6. Since July 1, 1996, how many public/government buildings in your area (excluding schools) have been upgraded or retrofitted for seismic safety?
- 7. Again excluding schools, and taking into consideration the earthquake hazard in your region, approximately what percentage of public/government buildings in your area are in need of seismic upgrades/retrofitting?
- 8. How would you prioritize that work on a scale of 1 (no priority now) to 10 (immediate concern).
- 9. Since July 1, 1996, have building/development/construction permits issued in your region been in compliance with your local seismic ordinances? Please rate on a scale of 1 (noncompliant) to 10 (fully compliant).
- 10. How many instances have there been in your region when building, development, and construction work were interrupted or otherwise affected because it was not in compliance with your local seismic safety ordinances?
- 11. How often do you review your seismic safety ordinances? Circle one:
  Annually After Elections Other (specify) Don't Know Does Not Apply
- 12. Who is involved in the review process? (*Please specify by title; if there is no review process, please indicate*)